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ECONOMIC GROWTH IMPACTS: A TECHNICAL DESCRIPTION OF AN OHIO MODEL FOR RURAL COMMUNITIES

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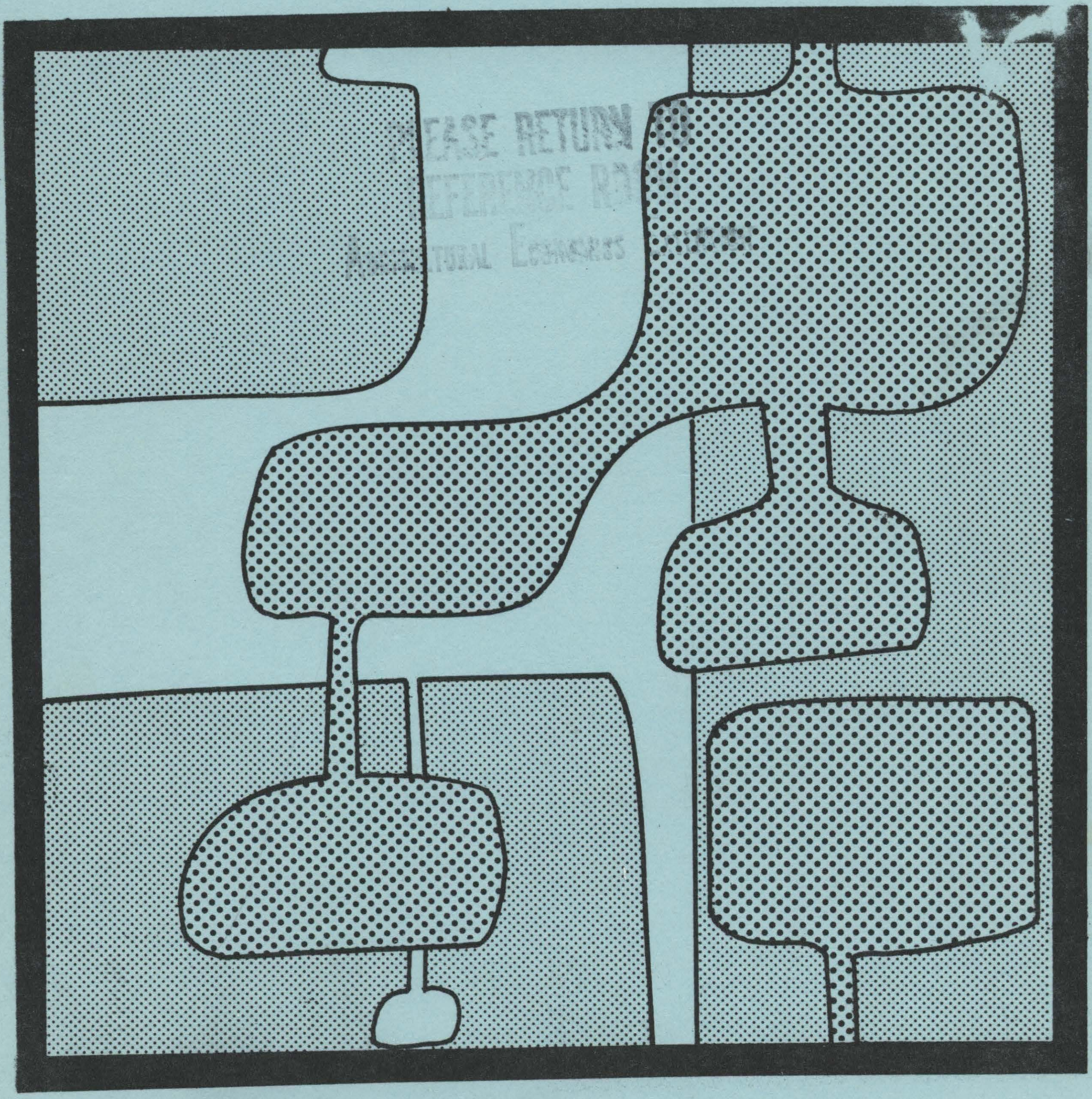

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A TECHNICAL DESCRIPTION OF AN OHIO MODEL

FOR RURAL COMMUNITIES

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ECONOMIC GROWTH IMPACTS: A TECHNICAL DESCRIPTION OF AN OHIO MODEL FOR RURAL COMMUNITIES

I. INTRODUCTION TO GROWTH IMPACT MODELS AS DECISION TOOLS

The purpose of the growth impact model described in this paper is to provide local leaders with information on the economic impacts of local growth policies. Policies which can be studied on a local level include annexation, creation of industrial parks, extension of water and sewer lines, and other forms of public assistance to new businesses. Local governments currently deal with these issues, but most rural communities cannot afford large-scale models for estimating the advantages and disadvantages of such actions.

The Ohio Economic Growth Impact Model estimates the changes in private sector incomes and local public sector revenues and expenditures from the expansion or location of a firm in a community. The model estimates the annual net revenues to a city, county, and school district for up to 20 years. From these estimates, the present values of the net changes are calculated. This permits a community to determine the maximum investment in inducements which could be offered to a firm without increasing tax rates or adversely affecting local government services. The present value of benefits from different types of firms can be used

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to narrow the list of potential firms to contact in promotion campaigns.

Frequently, the employees of a new plant reside in several different political subdivisions. If the present value of the net gains is estimated for each governmental unit, this provides a means of dividing the cost of inducement between them.

The effects of tax abatements can be examined with the model. The net changes in revenues can be compared with and without the abatement. However, the desirability of providing an inducement of this type to attract the plant must be evaluated locally. The model simply describes the outcome if an abatement is provided and if the firm locates in the community. This information can be useful, however, since often only the forgone revenues are considered.

Examples of the policy applications of the model are reported in two other publications (Morse-1978 and Morse-1979a). A third publication describes the data required for the model, the sources of primary data, and how to interpret the computer printouts generated by the model (Morse and Gerard).

This bulletin provides a technical description of the model and its estimation procedures. The next section describes criteria of growth impact models for rural communities. Section three outlines the general form used in the impact model. The estimation procedures and data requirements for applying the model to Ohio are described in section four.

II. CRITERIA OF GROWTH IMPACT MODELS FOR RURAL COMMUNITIES

Private consultants offer several growth impact models to local governments. The charge for these services range from \$2,000 to \$25,000 (Burchell and Listokin). These models have not been used widely by small rural communities due to both the high cost involved and the need for a specialized local planning staff. Consequently, agricultural economists in Indiana, South Dakota, Texas, and Florida have developed computerized models based on the Shaffer-Tweeten model.[1/] These models were developed for use both as educational tools through the Cooperative Extension Service and as a decision-making tool for city and county officials.

Growth impact models should meet the following criteria to be useful as a decision-making or educational tool in small rural communities:[2/]

1. The impacts should be specific to the local government unit making the economic development decision.
2. The results should be available on a timely basis consistent with the decision-making schedule.
3. The cost of data collection and analysis should be relatively low.
4. The estimation procedures and data assumptions should be both explicit and publicly available, allowing local users to adjust key assumptions at a reasonable cost.

1/ See Shaffer-Tweeten-1973, Darling-1976, Morse-1976, Jones-1977, Clayton-Whittington-1977, and Darling-1979.

2/ Many of these are criteria for any impact model and not just ones for rural communities.

5. Estimates should be made for local fiscal impacts; i.e., the changes in the expenditures and revenues of city, county, and school districts.
6. The changes in local budgets should reflect the cost of maintaining tax rates and the quality of public services at their pre-development levels.
7. Estimates should be made for the increase in incomes to employees and the service sector in the city and employees in the county.
8. The model should accurately reflect local and state institutions and conditions such as:
    a. population growth or decline
    b. property tax institutions
    c. state aid formulas
    d. tax abatement or other inducement programs
    e. excess capacity in public services
9. The impacts should be shown over time if underlying trends or the tax system lead to variation in the results over time.

Let us now explore the rationale for each of these criteria.

The Local Perspective of Growth Impact Models

The results of the model should provide relevant information for specific units of local government if the model is to be used as a decision-making tool. If the model can only predict the results at the regional or state level, city and village officials are unlikely to use it for local policy decisions. Until recently, most benefit-cost analyses had a national perspective.

"Benefit-cost analysis is a technique for assessing the economic utility of a public investment project" (Burkhead and Miner, p. 206). Prest and Turvey write: "Cost-benefit analysis is a practical way of assessing the desirability of projects where it is important to take a long view (in the sense of looking at repercussions in the further, as well as the nearer, future) and a wide view (in the sense of allowing for side effects of many kinds on many persons' industries, regions, etc.); i.e., it implies the enumeration and evaluation of all relevant costs and benefits" (p. 683).

These definitions raise several questions. What is "practical" for small rural communities? Is a means of analysis which is "practical" for large regional projects (often supported by federal grants) necessarily practical for small rural communities? What should determine the type of side effects to be considered? Are "relevant" costs and benefits the same for local decision makers as for regional and national decision makers? Will a method of analysis in which a national perspective is implicit provide local decision makers with relevant information?

Mishan and Krutilla and Eckstein suggest that the key issue is to clarify the perspective. For the model described in this circular, the perspective is at the local level. Benefits and costs are considered only for the city, county, and school district in which the plant locates. Spillovers of either benefits or costs to neighborhood areas are not included. If there are such spillovers which appear to be significant, the data can be adjusted and the model rerun for neighboring areas.

Time and Cost Factors in Local Decision-Making

The timeliness and cost of impact analysis are key factors for rural communities. If the estimates cannot be done quickly, the model generally will not be useful as a decision-making tool. In many cases, city and county officials have only a few days to consider the possible inducements to offer an expanding or new business. Obviously, an analysis completed in several days may require more unverified data than one completed in six months. If the decision time is determined by local events and not the method of analysis, then this is an irrelevant comparison. In such cases, the quality of the analysis with a model should be compared to the informal decision processes without a model.

Computerization of the model speeds up calculations, reducing the cost and making examination of alternative sets of assumptions feasible. The use of default data also reduces the cost of using the model, but may reduce the accuracy of the results. As a first approximation of the impacts of a new firm or local policy, default data may provide useful insights.

Explicit Assumptions in Analysis

Data for some of the key variables needed to estimate growth impacts do not exist before a firm locates or a policy is enacted. The basic research available is not yet adequate to predict this data within acceptable confidence intervals. However, it usually is possible to determine upper and lower limits for many of these variables.

The computerized model only requires the users to be explicit about their assumptions rather than requiring more assumptions. As Dorfman and Jacoby write:

> All methods of decision making require simplication ....The simplications required for mathematical analysis are less disabling than the simplications that are conventional in more informal procedures. Only hard experience can determine how practical and helpful mathematical analysis will be in actual instances, but the fact that they must invoke some serious simplications is not _ipso_ _facto_ decisive (p. 229).

Sensitivity analysis may be used to handle this problem. Local decision makers and "experts" can be asked for their subjective estimates. These estimates can be used to derive an expected value and upper and lower limits. Analyses can then be conducted with the expected value as well as with the extremes to determine the sensitivity of the results to these changes.[3/] This may help local officials understand the relative importance of various factors which influence the fiscal impact of their actions.

Breakeven analysis may also be useful. General analyses are made changing only a selected factor, so that the factor's minimum acceptable value (the point at which additional revenues equal additional costs, or break even) may be estimated. This may help local officials realize how much they can give in the give-and-take of industrial development.

Separation of Private and Public Sectors

Benefit-cost analysis focuses on allocative efficiency, where efficiency is defined in terms of the net value of output per unit

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3/ This is a common practice with the discount rate in benefit-cost analysis.

of input. The allocative efficiency criteria ignores consideration of who receives the benefits and who bears the costs as resource allocation alternatives are compared. Consequently, net benefits are defined as benefits in excess of costs in the aggregate sense, regardless of how the benefits and costs are distributed.

Ignoring how the benefits and costs of an action would be distributed may determine if a program is actually adopted. For example, most industrial development programs have aggregate net benefits which are positive. So in principle, it is possible for the private sector beneficiaries to fully compensate all of the taxpayers who might pay additional taxes as a result of local inducement policies. However, if these compensations are not actually to be paid, the community may delay or even defeat the use of local inducements (Haveman and Weisbrod, p. 175).

An additional reason to separate the impacts of private and public sectors is that local governments are usually required to maintain balanced budgets, regardless of the size of private sector benefits.

Environmental and Public Service Quality

The impacts of growth on environmental quality can be handled in several ways. Several accounting systems and environmental models have been developed to estimate the amount of pollutants generated by different forms of growth.

Input-output matrices for waste flows have been linked to the standard transaction matrix to allow tracing of these pollutants (Leontief, Hunker and Davis, and Cumberland and Korboch). The advantage of this approach is that both the direct and the indirect impacts on waste production can be determined. The disadvantage is that there are enormous data requirements. Consequently, the local application of this technique requires adjustment of national coefficients. Differences in the technology or product mix of the new plant from national averages can bias the local coefficients.

A second approach is to incorporate the cost of waste treatment or recycling in the local government's additional expenditures. If the new plant would require additional sewage treatment capacity to be built in order to maintain stream quality, this cost could be included. Likewise, the cost of maintaining the quality of all local government services at their pre-development level is included in the costs.

The third approach is to study the environmental impacts separately. In some cases it may be technologically impossible to fully treat or recycle all pollutants. In such cases, either the first approach or other *ad hoc* estimation procedures are needed to consider these impacts.

In this model, the focus is on the costs of maintaining the quality of services at pre-development levels.

State Institutions and Length of Analysis

State institutions which require special attention are: 1) state aid to education, 2) property tax laws, and 3) tax abatement laws. In some states, these institutions necessitate estimation of impacts over a ten to twenty year period.

Results for the first full year of operation can be misleading due to these institutions and population growth or decline exogenous to the firm being examined.

Aid to Education

State basic aid to elementary and secondary education is primarily a function of local property wealth per student and local tax effort in at least 10 states. In these states the use of the average state aid per student to project future levels of aid is misleading. Growth may increase or decrease the level of state aid depending on the ratio of new property values to the number of students.[4/]

Real Property Tax Freeze

Several states have total or partial freezes on increases in property tax revenues due to inflation of property values. In Ohio there is a freeze on the revenues from most property tax millage. If expenditures increase due to inflation, initial net revenue gains due to growth may be reduced or reversed over time. If only the first-year impacts are examined, it is implicitly assumed that the inflation rate will be zero over the next twenty years.[5/]

Tax Abatements for Real Property

Tax abatements are offered in numerous states to attract new job opportunities. The length and nature of the abatements vary

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4/ The South Dakota model examines the first six years but the Indiana, Texas, and Florida models only forecast the first-year impacts (Morse, Darling, Jones and Clayton).

5/ The zero inflation rate is obviously a stronger assumption than 4 to 6 percent. While it is currently impossible to predict the inflation rate, it is likely to be positive.

by state and sometimes even within a state. The present value of the net impacts depends on the length of the abatement. This is another reason for estimating net impacts for a number of years.

Exogenous Population Growth or Decline

Exogenous population shifts are defined as the changes in population occurring in the community without the addition of the firm being examined. These changes can affect the fiscal impacts in several ways. For example, consider the impacts on school enrollments and expenditures of a firm whose in-migrant employees add 100 new children to the district's elementary school.[6] There are three elementary school districts each with enrollments of 1,000 students prior to such a firm moving to the area. District A is expected to remain at this level over the next ten years. District B is expected to lose 300 students by the tenth year while District C is projected to gain 300 students during this period.

In each district, how many of the 100 new students coming into the area should be counted as an impact of the new plant? And how can expenditures be expected to change? How will current or future excess capacity affect expenditures?

One perspective is that the 100 additional students in the district after the addition of the plant will require 100 more spaces than before the plant regardless of the enrollment base. This straight forward before-after approach needs to be explored

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[6] This section is drawn from Morse-1979. See this paper for more detailed discussion of this issue.

more carefully before reasonable expenditure predictions can be made.

Assume that each of the three school districts had student enrollment capacity of 1,100 students given its present physical facility. District A has excess capacity of 100 students and would require no additional capital expenditures now or during the next ten years to handle the growth from the new firm. District B would also not need any additional capital expenditures. In District C, however, the excess capacity will only be 50 students by year 2. Further, the physical facilities will be completely utilized by the fifth year due to the community's projected growth <u>without</u> the new plant.

As this simple example shows, the additional capital cost related to the firm hinges on the projected growth in the district <u>without</u> the firm. In districts currently with excess capacity and expectations of steady or declining enrollments, no additional capital expenditures need be included. In districts expecting growth, current excess capacity may not exist in a few years and increases in enrollment due to the growth policies will require additional capital expenditures, or at least speed the necessity of such expenditures.

The criteria described in this section limit the type of empirical model which can be developed. The local perspective combined with limited time and cost eliminate input-output or econometric models. For an individual city or county, both methods are too time-consuming and costly to be feasible.

The input-output technique also suffers from other technical problems. In very small, open economies the introduction of a new industry requires a new set of direct coefficients. The coefficients are only stable enough to use over a short term. Also, the cost of collecting sufficient data makes this approach unfeasible in most cases.

Econometric models at the local level do not allow the institutional detail required to explore specific policy issues. While econometric models can be developed conceptually, rural communities seldom have the necessary data for estimation.

III. DESCRIPTION OF THE CONCEPTUAL MODEL

The structure of this simulation model is based on earlier work by Shaffer and Tweeten. The private sector benefits follow the approach used by Osman and reported by Morse and Hushak. The model differs from earlier ones by adding detailed state aid components and explicitly considering variations in public sector impacts over time. The general features of the model are presented in Figure 1 and summarized in this section. Additional detail is then presented on each component of the model.

Overview of the Conceptual Model

Additional public sector annual costs due to growth are shown on the left side of Figure 1. Capital expenditures and site improvements for the new plant and/or expenditures to maintain the quality of services depend on the type of plant, the number of in-migrant employees, current excess capacity, the share paid by local government and the amortization schedule. Operational costs for the municipal, county, and school services are a function of

Figure 1

Flow Chart of the Economic Growth Impact Model for Rural Ohio Communities

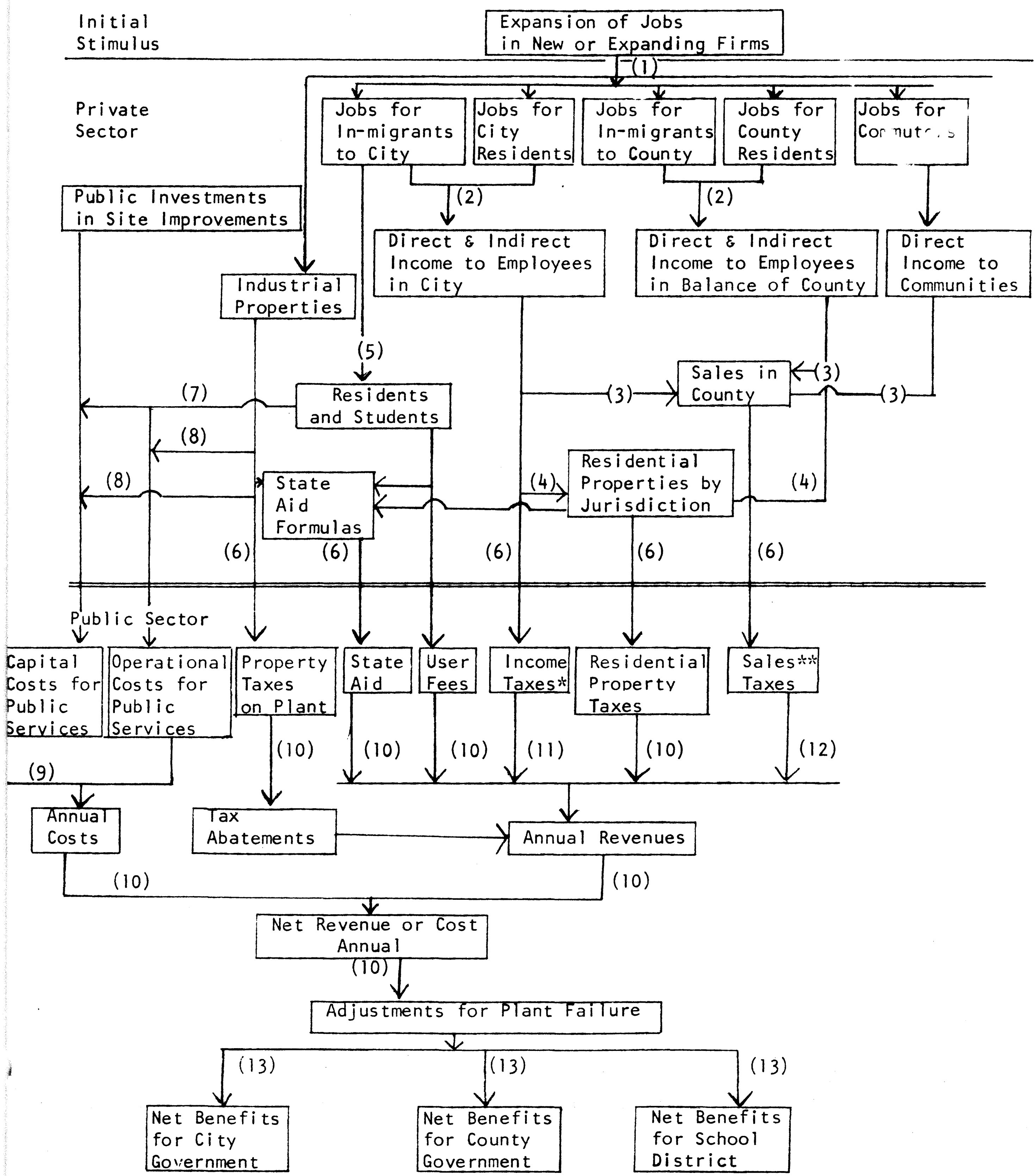

Figure 1, cont'd.

Legend of Coefficients:

(1) Residential distribution of employees

(2) Wage rates and income multipliers

(3) Marginal propensity to consume by area

(4) Marginal propensity to invest in housing

(5) Ratio of students and other residents to employees

(6) Tax rates for each unit

(7) Requirements for new population and current excess capacity

(8) Requirements for new plant and current excess capacity

(9) Share paid by local government and the amortization schedule

(10) Computed separately for the school district, municipal government, and county government

(11) Applies only to some municipal governments

(12) Applies only to some county governments

(13) Present value of the net revenue over n years, where n can equal 1 to 20

the number of new students, excess capacity, and special requirements for the plant.

Tracing the public sector revenue impacts requires the examination of private sector changes. Starting with an estimate of the total number of new jobs and the residential location of the employees, estimates are made of the number of employees originally living in the city, the number migrating into the city, the number originally living in the balance of the county, the number moving into the balance of the county, and the number commuting from outside the county.

The additional income to employees in the city and county is based on the plant's wage rates and local income multipliers. The increases in income include changes in income to plant employees in the municipality, other employees filling positions vacated by plant employees taking jobs at the new plant, and the multiplier effects in the service sector of the community.

The level of additional sales in the county is estimated using local marginal propensities to consume. Sales tax revenues can then be estimated for those counties having this revenue source. Income taxes are estimated directly for the municipalities which levy this optional tax.

Property taxes are estimated for both the new plant and for residential properties. The latter depends on the marginal propensity to invest in housing. Tax institutions which require tax freezes on part of the property tax base and periodic reassessments are included.

User fees and miscellaneous revenue are based on the number of new residents and previous per capita revenues from these sources.

State aid to education is a function of the number of students, local property wealth, and local tax rates. Municipalities and counties each receive one minor form of state aid which also varies with growth.

Private Sector Benefits

Private sector benefits are defined as the increases in the income of the municipality's and county's original residents as a result of a new or expanded firm. Only the original residents are considered because this appears to most closely reflect the constituency of local leaders at the time local growth decisions are made. Generally, local leaders are interested in improving the employment opportunities of residents in their community rather than unknown individuals who might move in to take new jobs.[7/]

Only increases in incomes, rather than the total payroll, are considered, because this most closely reflects standard welfare concepts. Changes in public sector revenues are related to increases in income, not total payroll.[8/] The definition of additional income used in this model measures the increases to plant employees and the increases to other employees filling positions vacated by plant employees taking jobs at the new plant.

7/ Clayton and Whittington also only look at original local employees but ignore income lost by unrefilled jobs.

8/ Increases to all local employees must be included for local public revenues.

Increases to other employees can be very significant in some circumstances. For example, a firm with a high average annual wage, which hires only previously employed high-income workers, yields relatively low benefits to plant employees. In contrast, a low-wage firm hiring primarily unemployed people generates high levels of benefits to its employees. If all of the jobs vacated by those hired by the high-wage firm are refilled, local incomes will obviously increase more than they would if a low wage firm of similar size were established. Morse and Hushak estimated that the addition of other employee benefits more than doubled the gain in original income for two of eleven firms studied in southeastern Ohio and was over 1.5 times the original change in nine of the firms (p. 13). This estimate was based on the conservative assumption that only 35 percent of the new plant employees' wages in their previous jobs would be captured by other workers within the region.

The Shaffer and Tweeten definition of private benefits only includes the additional income of the new plant's employees spent locally. Shaffer and Tweeten did, however, include local expenditures by in-migrants and commuters. This makes their definition somewhat broader than the local expenditures from the benefits definition in this model. However, this model assumes that the employees benefit regardless of where they choose to spend their increased income.

These alternative definitions are illustrated for a hypothetical firm in Table 1. The firm employs 100 workers with average annual wages of $10,000 for a total payroll of one million

Table 1

EXAMPLE OF ALTERNATIVE PRIVATE

SECTOR PRIMARY BENEFIT DEFINITIONS*

I.	Total Payroll at Plant		$1,000,000
II.	Payroll for Local Plant Employees		$800,000
III.	Increased Payroll for Locals		
	A.	Plant Employees	480,000
		Other Employees	320,000
		Total	$800,000
	B.	Plant Employees	480,000
		Other Employees	256,000
		Total	$736,000
	C.	Plant Employees	480,000
		Other Employees	0
		Total	$480,000
IV.	Increased Local Consumption		$141,000

*Calculations described in text.

dollars. However, only 80 of the employees are residents of the community where the plant locates. The second definition, payroll for local plant employees, shows a private sector benefit of $800,000.

To examine the conceptual definition used in this model, considerable additional information is needed. In this example, it is assumed the local employees consisted of 40 previously unemployed people and 40 previous job-holders with an average annual wage of $8,000.

Most of the previously unemployed workers probably received some type of economic assistance in the form of transfer payments. These payments could take many forms including unemployment compensation, aid to dependent children, food stamps, medicaid, and social security payments. For example, an unmarried, unemployed worker with no dependents typically receives $5,200 on an annual basis in unemployment compensation (although benefits are generally only provided for 6 months). Or, a woman, without a husband present, without unemployment compensation, but with children might receive $6,180 annually in transfer payments from aid to dependent children, food stamps, and medicaid.

If none of the 4 previously unemployed workers in the above example received any transfer payments, the benefit would be $400,000. The previously employed workers would earn $80,000 more than in their earlier jobs, giving a total of $480,000 for plant employees. If the workers were evenly divided between the two examples above, the benefit would be $172,400. The most likely benefit amount is somewhere between these two figures. The exact amount is dependent on the average level of transfer payments received and the proportion of the previously unemployed workers who received transfer payments. An *ex ante* determination of both, particularly the latter, is difficutt at this time.

In Case III-A, it is assumed that all of the vacated jobs are taken by local labor, that the annual salaries in these jobs remain unchanged, and that the employees taking the jobs were previously unemployed.[9] When this set of assumptions is used, the increase in other employee income increases the primary benefits to equal the payroll for local plant employees.

The definition used here--increase in incomes for local people--is the most consistent with the standard view of welfare improvement (Hushak). However, to use this definition requires four pieces of data seldom known *ex ante*: 1) wages of plant employees at previous position, 2) average annual gross value of transfer payments for unemployed workers, 3) the percentage of the new plant's employees previously employed, and 4) the proportion of vacated positions refilled by local workers.

Two factors can lead to lower benefits under the third definition in Table 1 as compared to the second. They are:

(1) Some employees filling vacated jobs may be commuters or in-migrants.

9/ The last assumption could be dropped by calculating the results for a series of job changes. The only strong assumption is that all of the jobs are refilled by local labor. Naturally some of the unemployed may out-migrate. But if there is sufficient local unemployment, there may still be enough labor to refill all vacancies.

(2) Previously unemployed plant workers or other workers must deduct transfer payments lost as a result of their new jobs.

For example, Case III-B shows the reduction in other employee benefits if only 80 percent of the other employees are local residents. The total increase is only 92 percent of the first case (III-A). In Case III-C all other employees are assumed to be in-migrants or commuters, reducing total benefits to only 60 percent of III-A.

The increased local consumption definition in Table 1 assumes commuters only spend 30 percent of their income in the community where the plant is located, while local residents spend 75 percent.

Net take-home income is used in the private sector of this model. Local multiplier effects depend on the net figure rather than gross increases in income. However, the Ohio income tax is based on gross income, so the public sector changes are based on the gross increase in payroll.[10/]

Residential Location of Employees

In addition to the total number of jobs created by a new firm, it is essential to estimate the distribution of these jobs among: 1) local residents, 2) commuters from neighboring cities, and 3) in-migrants. Generally, communities wish to expand job opportunities for local residents rather than for in-migrants or commuters from neighboring areas.

[10/] The Indiana model uses net payroll. Darling-1979.

Existing research does not allow us to estimate the residential location of a new firm's workers with a high degree of confidence. However, several recent works do provide some guidance on this question.

Research in southeastern Ohio indicates that over half (57%) of the workers employed in eleven new or expanding plants were originally from outside the municipality or township in which the plant located (Morse and Hushak). Five previous studies in other rural areas report similar results, with local employees receiving from 21 to 59% of the new jobs (see Table 2). In the southeastern Ohio study, those originally living outside the city or municipality (57%) were about evenly divided between the same county (27%) and other counties (21%), with 9% being in-migrants to the city (Morse and Hushak).

Muller suggests that the percent of employees commuting and migrating into a community is a function of the type of community, the duration of the employment, and the sex, age, and income level of the workers. Smith has attempted to develop a predictive equation for the percentage of in and out commuters and for in-migrants. The regression results suggest that in-commuters will be approximately 25% of the primary employment, ranging from 19 to 36 percent. The lack of a positive coefficient for the level of a county's total manufacturing employment suggests, however, that the in-commuters later become in-migrants.

A gravity model can be used to distribute in-migrants between various communities (Hertsgaard, et al.). The gravity model assumes that the level of commuting from neighboring communities is

Table 2

RESIDENTIAL LOCATION OF EMPLOYEES

	Living in Municipality or Township	Commuting from County or Region	In-migrant to Municipali v
Southeastern Ohio	43	48	9
Ravenswood, W. Va.	25	---------75--------	
Brookings, S. D.	21	32	47
Eastern Oklahoma	59	31	12
Ozarks	45	41	14
Missouri	47	30	12

1) George W. Morse and Leroy J. Hushak, "Income and Fiscal Impacts of Manufacturing Plants in Southeast Ohio," OARDC Bulletin 1108, Wooster, Ohio, March 1979.

2) Irwin Gray, "Employment Effects of a New Industry in Rural Areas," Monthly Labor Review, June 1969, pp. 26-30.

3) Dwight G. Uhrich, "A Case Study of the Economic Impact of the 3-M Company on the Brookings Community," unpublished M.S. thesis, Economics Department, South Dakota State University, July 1974.

4) Ron E. Shaffer and Luther G. Tweeten, "Economic Changes from Industrial Development in Eastern Oklahoma," Agricultural Experiment Station Bulletin B-715, Oklahoma State University, July 1974.

5) Calculated from Duane A. Olsen and John A. Kuehn, "Migrant Response to Industrialization in Four Rural Areas, 1965-70," Agr. Econ. Report 270, Economic Research Service, USDA, September 1974. To calculate this information it was assumed that all workers within 10 miles of the plant lived in the community and the rest commuted.

6) Norman J. Bucher, "Impacts of New Industrial Plants: A Case Study," Missouri Division of Commerce and Industrial Development, Office of Industrial Studies, University of Missouri, January 1971.

inversely related to the distance from the plant to the community and directly related to the size of the community. Jansma and Goode have reported an empirical investigation by Fink of labor force participation and commuting which incorporates the gravity model concepts as well as interviewing and competing employment opportunities.

Inflation and Discount Rates

Fiscal impact models vary in their use of inflation factors (Burchell and Listokin, p. 335). One argument against adjusting for inflation is that all prices would rise by about the same rate (Prest and Turvey, p. 691) and so the net result would be unaffected in constant dollars. A second reason to exclude the effects of inflation is so that the real impact can easily be compared over time. If current dollars are used, changes in results due to underlying structural changes may be masked by changes due to inflation.

Including changes in relative prices is a necessary and common practice in benefit-cost analysis (Prest and Turvey, p. 691). For example, in Ohio the real property tax revenues are partially frozen with respect to changes in property valuation due to inflation. While expenditures in local government may continue to inflate, property tax revenues increase at a much smaller rate. In order to recognize these relative changes, inflation must be incorporated into the model. Without this adjustment, changes in the fiscal impacts might go unnoticed.

In this model the wages of the firm are inflated at a rate exhibited by that particular industry during the past five years. The average annual value of the GNP deflator during the 1970's is used to adjust these to current dollars. This allows relative differences in inflation to be reflected in the results.

The discount rate is a critical variable in the model. Baumol argues that opportunity cost of the resources should determine the rate used. He writes "the correct discount rate for the evaluation of a government project is the percentage rate of return that the resources utilized would otherwise provide in the private sector" (p. 274).

While this view provides a starting point, the choice of a social discount rate involves value judgements on the timing of investments and benefits (Burkhead and Miner, pp. 228-236). Low discount rates will justify more and larger projects and ones with benefits further in the future. High rates will accept fewer projects and ones with more immediate results.

Riskiness of the project or policy also influences the discount rate. It is argued that on a national scale a large number of projects undertaken simultaneously makes government projects virtually riskless. At the local level considered by this model, the opposite appears true, justifying a higher than average discount rate. Further, if estimates are made for over 10 years into the future, this increases the uncertainty and risk. Additional justification for a high discount rate thus may be made.

Plant Failure Adjustment

If a new firm goes out of business after only a few years of operation, private sector benefits could be eliminated. Previous growth impact models have implicitly assumed that the plants remain viable throughout the period of analysis. As Table 3 shows, the rate of failure varies considerably from year to year and by industry. In this model the probability of failure is included as a variable, subject to user manipulation.

Multiplier Effects and Secondary Benefits

As the number of jobs expand, there may be a multiplier effect on the local service sector or through suppliers of intermediate products. Income multipliers can be derived using 1) economic base theory, 2) input-output analysis, or 3) econometric approaches.[11]

Due to data limitations and time constraints typical in using the impact model, the multiplier is estimated within the model using the following formula:

(Eq. 1) $$M = \frac{1}{1-PCL}$$

where

M = community income multiplier

PCL = weighted propensity to consume in the municipality by workers at the plant

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11/ The advantages and disadvantages of each approach are described by Shaffer-1979.

Table 3

PROBABILITY OF PLANT FAILURE

BY INDUSTRY AND AGE

Age of Firm (in years)	Manufacturing	Wholesale	Retail	Construction	Service	All
1	1.4%	0.9%	1.1%	0.5%	1.5%	1.1%
2	8.3	8.7	12.8	5.8	9.9	10.0
3	15.0	15.3	18.5	12.3	15.8	16.1
4	12.8	14.4	16.5	13.5	13.1	14.8
5	10.5	11.1	11.0	12.8	10.0	11.1
6	7.4	8.6	9.4	12.1	9.1	9.5
7	6.1	6.1	5.7	8.8	8.4	6.7
8	5.0	6.1	4.1	6.3	6.3	5.1
9	3.3	3.0	2.7	3.7	3.8	3.1
10	3.2	3.1	2.7	3.2	3.7	3.1

Source: The Business Failure Record, Dun and Bradstreet, Inc., 1978.

The income multiplier is assumed to take effect gradually over a six-year perio rather than instantaneously.[12/] The multiplier is adjusted in the following manner:

$$\text{(Eq. 2)} \quad B6(T) = B(6) - \frac{B(6)-1}{25} \times (T-6)^2$$

where

$B6(T)$ = income multiplier in year T

$B(6)$ = value of income multiplier when in full force

This results in a multiplier of one in year 1; i.e., no secondary impacts, but increases to the full multiplier by year 6. The model holds the multiplier at the sixth year level throughout the remainder of the analysis.

The <u>service sector benefits</u> include the value added from both the secondary benefits of multiplier effects and the direct additional consumption by new employees. The direct increase is the product of increased income, the marginal propensity to consume locally, and the ratio of value added to sales (see Appendix A, equations 7-13). This definition would result in double counting if aggregated with the other private sector benefits. In this model, it is kept separate to more clearly illustrate the distribution of benefits.

Impacts on Local Government Expenditures

The importance of adequate operationalization and accurate measurement of variables was stressed by James Bonnen in his 1975

12/ For a more complete discussion of this, see Morse and Hushak.

AAEA Presidential address. A crucial problem in determining fiscal impacts is to correctly estimate additional expenditures.

This section reviews and evaluates six alternative approaches for estimating the impacts of growth on local government expenditures. Those which require data on residential building site locations, configuration and density are not discussed in this section. Rather, the discussion is limited to procedures which estimate changes in expenditures on the basis of changes in total population, personal income, and the property tax base.

The department official estimates approach of the changes in local government expenditures has been used in several recent studies. The head of each service department has been asked what additional personnel and equipment his department would require as a result of growth.[13/] This approach is called the case study approach by Burchell and Listokin. They claim it is particularly appropriate when excess capacity exists.

To empirically determine excess capacity they recommend asking local officials to identify the "desired" service level. The amount by which the current level exceeds (falls short of) the desired level is the amount of excess (deficient) capacity. To use this concept, Burchell and Listokin suggest asking local officials:

> "Is there any excess capacity in terms of capital facilities or operational resources, with reference to the service you are responsible for, so that an acceptable service quality could be provided if existing facilities and manpower served a larger user population? If yes, please indicate the exact level of slack." (p. 50)

13/ Osman, Morse, Muller.

The authors provide this final advice when using this case study approach:

> "The key to successfully pinpointing excess or deficient capacity is detailed and careful interviewing of public officials. Officials fear it may justify reduced operating or capital funding. They may also hesitate to admit the exact magnitude of deficit capacity, because it may appear to be poor planning. The cost revenue analyst must be aware of these factors when he considers officials' response." (p. 52)

After obtaining information on the number of new employees, new residents and new students, Burchell and Listokin (pp. 53-56) suggest estimating the number of additional public employees needed if community standards are utilized. Then the department officials are reinterviewed and asked:

> "What is the expected reaction to accommodate a population change of ---- (specify projected total and student population changes); induced by ---- (specify development proposal, zoning change, annexation, redevelopment, etc.); at ------ (specify location)? Will any additional staff be hired?...Will capital facilities be added or expanded? If so, exactly what additions or expansions are anticipated?"[14/]

If the proposal also includes a non-residential development, also ask:

> "What is the expected reaction to accommodate a ------ (specify the general type and size of non-residential facility...) induced by ------ (specify development proposal, zoning change, redevelopment, etc.): at -----(specify location, especially in reference to existing roads and highways and utility and sewerage service networks)?[15/]

The questions on staff and capital facilities are also reported.

Judging the accuracy of the public officials' response is the major problem with this approach. Political budgetary concerns

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14/ Burchell and Listokin, p. 55.
15/ Burchell and Listokin, pp. 55-56.

can easily become part of the considerations. Muller (1975) suggests that the case study approach frequently underestimates required increases in expenses. A case study in southeastern Ohio found both under and over estimates of expenditure impacts depending on the political aggressiveness of the local officials (Morse-1978).

The advantage of this approach is that it encourages participation of service department personnel in the estimation of growth impacts. Each department head may be sufficiently familiar with his department to know: 1) whether excess capacity currently exists, and if so, how much, 2) whether economies of scale could be realized if the service expanded, and 3) whether any unique circumstances are present. However, if explicit operational definitions of excess capacity and budgeting procedures for exploring economies of scale do not exist, this may be an unrealistic expectation.

A weakness of estimates by local officials is that there frequently are no standard criteria by which to compare the estimates. Do the estimates ensure that the quality and quantity of service to current residents will be maintained? Or will the estimates result in existing personnel being distributed over a large population, reducing the quality and quantity of services originally provided? How is output quality and quantity measured in the estimation procedure? There are few explicit standards or measurement procedures for judging the quality or quantity of public services. As a result these questions may be very difficult to answer even for those delivering the services.

At times there may also be incentives for a department head to over or under estimate necessary expenditure growth resulting from the expansion under consideration. This is especially the case when the department is inadequately staffed for the current population and is being asked to assume additional responsibilities.

The expenditures per capita approach is a second means of estimating additional expenditures. Using this procedure, the total additional expenditures for this unit of government would be the product of current per capita expenditures and the number of new in-migrant residents.[16/]

To purge the influence of non-residential development from the per capita estimates, Burchell and Listokin recommend the use of a proportional valuation technique (p. 31). The proportion of non-residential to total local real property value is assumed to reflect the proportion of municipal expenditures attributable to non-residential uses. After deducting the non-residential municipal expenditures, the remaining expenditures are divided by the population to obtain per capita expenditures.

Essentially, this procedure assumes that there is no excess capacity in the current services, and that there are no economies

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16/ Burchell and Listokin call this the "per capita multiplier" approach (pp. 25-44). Battelle Laboratories used the expenditure per capita approach for estimating changes in city and village expenditures. The population was divided into 3 categories: 1) permanent residents, 2) permanent plus travelers, and 3) permanent plus commuters. Travelers commute to the area and stay throughout the work week. The expenditures were highly disaggregated and a few were assumed not to change.

of scale. It also ignores differences in expenditures per capita as a result of increases in income or changes in other socio-economic characteristics. The principle advantages of this approach are its simplicity, low data requirements, and availability of information from local budgets.

The community service standards approach establishes the amount or number of personnel or other inputs per thousand population. The standards can be developed from two sources. The current input-output relationship in the community can be utilized or standards recommended by state agencies or interest groups could be used. If the former is used, this approach is no different than the expenditure per capita approach.

Burchell and Listokin have reported service standards in terms of the number of full-time municipal employees per 1000 workers for ten municipal functions and elementary and secondary schools. The standards are based on 1972 Census of Government data for municipalities under 50,000.

This data allows a standard definition of excess capacity. For example, the standard for police in communities of 10,000 to 25,000 is 1.72 per 1000 people. So a community of 15,000 with 30 police officers would have an excess capacity of 4 officers. An increase in population of 2,000 persons in a community of this size would usually require an increase of 3.44 police officers. But given the community's excess capacity, no increase would be needed.

The number of additional employees is multiplied times the average expenditure per employee. Annual capital costs can also be added using ratios of capital to operating costs.

Burchell and Listokin claim the data on service standards is better for mid-sized, moderately growing areas than for either large or small areas with rapidly changing populations. This method cannot be used with solely nonresidential proposals. However, it does provide useful information on individual services at a low cost.17/ The expenditure estimates from the community service standards do not assume average and marginal costs are identical since it allows explicit treatment of excess capacity. If it is assumed that no excess capacity currently exists, regardless of the current resource levels, then this method assumes average and marginal costs are identical.

In cross-sectional analysis expenditures for each service are compared for different communities with data from the same year. Regression analysis allows an examination of the relationship between expenditures per capita and community population, the rate of growth of community population, income levels, age distribution, educational levels and other socio-economic characteristics. The development of a predictive formula by the use of regression analysis allows the projection of expenditures given local data on each of the independent variables.

Regression coefficients developed from a sample of existing schools may confuse the rate of utilization of a school of a given scale with changes in cost due to changes in scale (King and Wall). Control for differences in local preferences and the

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17/ Burchell and Listokin, pp. 68-70.

quality and mix of educational services is also very difficult. Generally, the regression analysis also focuses on variable costs rather than capital costs (Prest and Turvey).

In many cases regression analyses have not been done for individual services at the state or local government level.[18/] However, the major disadvantage with this approach is that it assumes the communities' existing services are at capacity and cannot handle situations with significant excess or deficient capacity.

The comparable city method projects changes in expenditures related to city size and the rate of change in population.[19/] The major advantage of this approach is that it allows the consideration of population decreases as well as increases. Additionally, these projections are easy for local officials to understand since they are based on the similar communities. The major disadvantage is that the coefficients are based on residential growth and do not apply to industrial or commercial growth.

The key aspect of this approach is the determination of the appropriate expenditure multipliers. "The multipliers represent the ratio of per capita expenditures for communities of a particular size and growth rate to the per capita outlays for the

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18/ Burchell and Listokin report on coefficients for seven municipal services. The authors indicate that other variables included in the analysis were income, wealth, and tax base (p. 147), but provide no additional information on the regression analysis. The studies from which these coefficients are derived utilize data from 1957 to 1975 and are listed in note 2 on page 147.

19/ This discussion is drawn from Burchell and Listokin, pp. 97-118.

largest group of mid-sized cities, i.e., those mid-sized communities whose size and growth rate are most common." 20/ For example, a multiplier of 0.7 means the median per capita expenditure of a community is 70 percent of that for communities from 25,000 to 50,000 with an annual population growth rate of 2 percent or more.

Given data on the current community size and growth rate, the current multiplier is found. The future multiplier refers to the area after growth. Current per capita expenditure is multiplied by the future/current multiplier ratio to obtain future per capita expenditure. To determine the net cost attributable to growth, the current costs are deducted from the product of future per capita costs and the future population.

Except for large shifts in population, this approach will yield the same results as the per capita expenditure approach since the ratio of future/current multiplier will be one.

The economic-engineering approach (EE) may also be useful in growth impact models. Mackey describes it:

> The EE approach starts with the engineering qualities needed to produce a service (e.g. sewer) and then adds cost for each engineering phase--thus a production function for the service is developed. This production function can be expressed with explicit assumptions about the physical/engineering impacts and costs. 21/

For example, for police services Mackey used seven assumptions to derive total annual costs. These include the number of officers and staff needed per 1000 new employees, the annual

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20/ Burchell and Listokin, p. 103.
21/ Mackey, p. 1.

salaries and fringe benefits of the officers and staff, the relationship of equipment and supplies to wages, the number and value of vehicles, the relationship between replacement costs and annual operating costs, and the square footage per employee. The approach suggested by Mackey uses so many fixed proportions that no economies of scale result for police services. Consequently, an estimate based on the economic-engineering approach would be very similar to an estimate based on the per capita method.[22]

A more detailed economic-engineering approach is being developed by Schmidt and Doeksen and by King and Wall. For police expenditures, Schmidt and Doeksen estimate the number of calls for different types of services: violent crimes, property crimes, traffic calls, and public service. The estimates are based on regression coefficients for the variables of population and males aged 15-35. Then a budgeting procedure is used to estimate operational and capital costs. This approach provides much more detail than Mackey or any of the other expenditure approaches. Obviously, one disadvantage is the time required to use this approach.

Effective demand for services is not explicitly treated by the economic-engineering approach. Conceptual and empirical problems abound in incorporating effective demand. If comparisons in net revenues are to be made with and without growth, the quality and quantity of services provided per capita

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22/ Slight differences might occur due to the lumpiness of inputs for the EE approach. For example, when do you actually add a new officer as population grows? Is it only at the 1000 mark or continuously through the use of overtime?

must be held constant. If in-migrants increase the effective demand for some local government services, should the additional costs of the increment due to expanded service be charged to the project? If so, how are the net revenues interpreted? In this study it is assumed that changes in effective demand should be ignored. If the intent of the analysis is to predict the actual expenditures and revenues rather than to compare those which would occur if service quality is held constant, demand determinants must be considered.

Summary on Expenditure Estimation

Six estimation procedures were reviewed for predicting growth-induced changes in local government expenditures: 1) department official estimates approach, 2) expenditures per capita approach, 3) community service standards approach, 4) cross-sectional analysis, 5) comparable city method, and 6) economic engineering approach. The characteristics of these procedures are summarized in Table 4. None of these have all the desired attributes.

Only the cross-sectional analysis and the department official estimates can handle industrial or commercial developments. Unfortunately, the latter is subject to political bias since no standard methods exist for defining excess capacity, especially for non-residential activities. The community service standards approach provides criteria relevant to the definition of excess or deficient capacity but it only applies to residential development. The economic-engineering approach has all the desired characteristics required to compare expenditures at given levels of

Table 4

Characteristics of Alternative Expenditure Estimation Procedures for Municipal and County Government

Method	Types[a] of Uses	Excess or Deficient Capacity Handled	Data Available	Detail on Services	Political Biases	Population Decline Handled	Demand Determinants Considered	Time Required (Hours)
Department Official Estimates	All	Yes	Yes	Yes	Yes	Yes	Yes	261
Expenditures Per Capita	R,LU,V,A,&E	No	Yes	No	No	No	No	32
Community Services Standards	R,LU,V,A,&E	Yes	Yes	Yes	No	No	No	31[b]
Cross-Sectional	N	No	Yes	Yes	No	No	Yes	27[b]
Comparable City	R,LU,V,E	No	Yes	Yes	No	Yes	No	36[b]
Economic Engineering	All	Yes	Yes	Yes	No	Yes	No	?[c]

[a]Types of uses: R-Residential, N-Nonresidential, LU-Land Use Alternative, V-Variances/Rezoning, A-Annexing, E-Environmental Impact Statement, UR-Urban Renewal.

[b]These are Burchell and Listokin estimates adjusted to equal 22 hours obtaining the necessary data and estimating current per capita expenditures. The authors did not use the same procedure in estimating costs.

[c]This approach ought to take less time than department official estimates, but more than the others.

effective demand. However, it may require more time and resources than are available. If actual expenditures, under varying levels of demand, are considered, then economic-engineering is inadequate and cross-sectional analysis or departmental officials may be more promising.

IV. OPERATIONALIZATION OF THE MODEL FOR OHIO

The operationalization of this model for Ohio is described in this section. The estimation procedures and data requirements are described, as well as public finance institutions which require special treatment. Description of the procedures for private sector income changes are followed by a discussion of the procedures used for revenues and expenditures.

Estimation Procedure for Private Sector Income Changes

In this model the conceptual definition for private sector benefits is the increase in the incomes of the municipality's and county's original residents as a result of new jobs in the area. This includes not only the increases in incomes of the employees at the new or expanding plant but also for those moving to recently vacated jobs as a result of this plant. The multiplier effects on the local service sector are also included.

When this model is used *ex ante* the data collection and operationalization of the model is much more difficult than in *ex post* applications. Several alternatives exist for operationalizing the model but none are completely satisfactory. Additional research is needed to improve the linkage between the conceptual and operational definitions.

Some currently available options for estimating income changes are examined here. The value of annual income in the previous job might be found by categorizing jobs by occupation and skill level and then determining the average paid in the county for each category. A second alternative is to use data from a previous ex post study to set upper and lower limits of the percentage increase in annual incomes. For example, in southeastern Ohio the increases in incomes with nine durable manufacturing firms ranged from 26 to 80 percent. The median increase for these nine firms was 37 percent.23/

To empirically estimate the private sector benefits in a fashion which approximates our conceptual definition, the additional income of local employees should be reduced by an income leakage factor. The income leakage factor is the percentage of local payroll lost to the community as a result of vacated jobs not being refilled by local persons and by the loss of transfer payments.24/ Table 5 reports the income leakage factors for ten southeastern Ohio firms for the city and county. In the four largest firms in this study, the income leakage factors had a weighted mean value of 28 percent of the local payroll in the city and 69 percent in the county.25/ When the six smaller firms are

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23/ These were derived from the results reported by Morse and Hushak, see Appendix D for their derivation.

24/ Darling assumes that there will be no income lost due to unfilled vacated jobs if the unemployment rate exceeds 5%.

25/ This estimate was derived from the data and Morse and Hushak, assuming that other employee benefits at the level would be distributed geographically in the same fashion as plant employee benefits.

Table 5

INCOME LEAKAGE FACTORS
FOR FIRMS IN SOUTHEAST OHIO

Firm	Number New Employees	Percent Distribution of Residential Location+		Income Leakage Factor	
		City	County	City (%)	County (%)
1	175	55	33	35	72
2	228	61	15	16	52
3	80	31	12	10	78
4	44	39	52	11	85
5	24	63	38	0.1	82
7**	17	35	30	50	46
8	3	0	100	*	76
9	3	0	100	*	80
10	3	0	100	*	73
11	3	100	0	26	*
Weighted Average	62	52	24	22	40

*Undefined since no employees lived in this area.
**Firm 6 is deleted because of inadequacies in the data.
+Percentages may not add to 100 since some workers originated from outside the county.

Source: Morse and Hushak.

included, the weighted average is 22 percent for the city and 40 percent for the county. In this model a default value of 30% is used for the income leakage factor in the city and 70% for the county. These estimates are used because previous empirical research is weak and these values result in more conservative revenue estimates.[26]

In summary, the primary benefits in the private sector of the city are estimated by the following equation:

(Eq. 3) D(1,1,T) = WAGES * NOEMP(1) * (1-L)

* ((1+INFLAT(1)) ** (T-1))

where:

D(1,1,T) = increased income in year T to employees living in the city

WAGES = average annual gross income at the plant

NOEMP(1) = number of plant employees living within the city

L = income leakage factor

INFLAT(1) = annual rate of change in wages

T = year of impact from 1 to 20

Growth Impacts on Ohio's Local Government Revenues

Property taxes provided 51 percent of Ohio's locally raised government revenue and 30 percent of local government's total revenues in 1977 (see Table 6). They form the primary source of revenue for schools and counties. Sales taxes are also important in many counties. Municipal income taxes is a major source of

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26/ Additional research is being conducted on rural labor markets to develop a better means of predicting the increase in wages on an *ex ante* basis.

Table 6

REVENUE SOURCES FOR OHIO MUNICIPALITIES, COUNTIES, AND SCHOOL DISTRICTS: PERCENTAGE DISTRIBUTION IN 1977

	Municipality (%)	County (%)	School (%)	Total (%)
Property Tax	11.1	19.5	45.1	30.0
Income Tax	24.6	0.0	0.0	7.2
Sales Tax	0.3	4.2	0.0	1.0
State Aid	12.8	37.7	33.1	28.1
Federal Aid	17.8	7.9	12.3	13.0
Other	33.5	30.8	9.5	20.9
	100.0	100.0	100.0	100.0

Source: 1977 Census of Governments

revenue in many Ohio cities and villages. State aid is an important source of income for school districts.

This section describes the impacts of population or economic growth on local revenues and the estimation procedures used in this model. These revenue sources are discussed for each of the three local governmental units. While the rates differ, the property tax system is identical for all three units so it is discussed in one section.

Property Tax Revenue Changes

The new plant's real property taxes may be an important source of new income. In Ohio, real property, i.e., land and buildings, has a taxable value of 35 percent of its market value. Local tax revenues, prior to recent adjustments, could be calculated as the product of the market value of the property, the assessment ratio (35%), and the millage rate.

Recent legislation established a tax reduction factor which essentially "eliminates increases in revenues from voted taxes which might occur when existing real property in a taxing unit is reappraised or updated."[27/] This legislation became effective for the 1977 collections. This means that inflationary increases in property values will only generate additional tax revenues on the inside millage.[28/]

27/ Ohio's Taxes, p. 40, 1977 Annual Report of the Department of Taxation, pp. 111-120, or R. C. 319.301.

28/ Inside millage refers to 10 mills total in a county which may be levied without a vote of the people. The outside millage is simply tax levies which are put into effect by a vote of the people.

Two other recent tax credits need to be considered: (1) the ten percent rollback and (2) homestead exemptions. While both of these reduce the individual taxpayer's property tax liability, local governments are reimbursed by the state for this loss.[29] As a result, neither affects local government revenues.

An estimate of increased real property tax revenues from the new plant may be derived from equations 21, 34, and 45 in Appendix A. These equations calculate estimates of changes in revenues from inside and outside millages separately. A user-selected inflation rate for real property is applied to the plant's valuation for the inside millage.

Because Ohio has a "freeze" on real property tax revenues from outside millage, half of equations 21, 34, and 45 need no adjustment for inflation. In fact, the valuation used with outside millage is reduced to 1977 levels by application of the appropriate tax reduction factor.[30] Technically, tax reduction factors do not reduce the property valuation or the tax rate, only the individual taxpayer's liability itself. But as used in this model, reduction factors may be thought of as acting on the valuation of real property since the effect is the same.

Ohio's "Area Reinvestment Program" allows cities or counties to grant tax abatements to new or expanding firms.[31] No taxes are

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29/ Ohio's Taxes, p. 40. The assessments are increased in three-year cycles. See Appendix E for a description of this.
30/ See Appendix C for a discussion of tax reduction factors.
31/ For a complete discussion of this program, see Digest of State Programs Urging Development.

collected on improvements to real property during the period that an abatement is granted. The city or county may decide if and how long (up to 15 years) an abatement will be given to a business.

Home improvements will also yield additional real property tax to local governments. Ex ante, no information is directly available on the value of new homes or home improvements due to the new plant. To approximate the increase, it is assumed that the ratio of home values to annual gross incomes remains constant. The user can specify the value of this ratio, or a default value of 2.0 will be used, based on a rule of thumb frequently used by lending institutions.

A tax abatement may also apply to improvements to homes in the reinvestment area. The user of this model can specify the proportion of the housing improvements expected to fall within this area. Equations 22, 35, and 46 in Appendix A are used to estimate the increased property tax revenues of new homes.

Tangible personal property tax revenues are estimated for the new plant. This tax is applied to machinery, equipment, and inventories of Ohio businesses. The taxable value in 1979 was 44 percent for machinery and equipment, 39 percent for inventories, and 100 percent for public utility equipment. Except for public utility equipment, the assessment ratios will decline by two percentage points each year until they reach 35 percent.[32/] Tax reduction factors do not apply to tangible personal property. Tangible personal property tax

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32/ R. C. 319.301, 5711.22, etc. from Am. Sub. H. B. 920. See 1977 Annual Report of the Ohio Department of Taxation, pp. 68-70.

revenues are estimated with equations 26, 38, and 48 in Appendix A.

Current tax rates are used in the revenue analysis, even though they may change over the period considered. The results of these calculations show the revenues which may be expected if tax rates remain at current levels. It is recognized that tax rates may increase or decrease over time as a result of various local conditions. However, communities usually hope that growth will not result in heavier tax burdens. Using current tax rates provides a standard for comparison of alternative local development policies.

Municipal Revenue Changes

The additional revenues collected by a municipality in year T as a result of the new plant are the sum of changes in revenue from the following sources:

A. Local Revenues:

(1) income taxes

(2) property tax from the new plant real property

(3) property tax from tangible personal property

(4) property tax from housing improvements

(5) user charges, fees and miscellaneous revenues

B. State Aid: 33/

(1) motor vehicle license fees

C. Federal Aid:

(1) revenue sharing

33/ A number of other forms of state aid is received by municipalities. However, only motor vehicle license fees appear to vary with growth. See discussion on pages 49 to 51.

The local income tax is the most important local source for most Ohio cities. Procedures for estimating income taxes and user charges, fees and miscellaneous revenues will be discussed. Seven state-levied taxes are returned to municipalities but only one, motor vehicle license fees, changes in a predictable fashion as growth occurs. The others are described in Appendix B. Likewis , only federal revenue sharing changes with local growth.

Municipal income taxes are levied by 406 cities and villages.[34] The tax rate is determined locally and can vary from one-fourth to 1 percent to 2 percent. The maximum rate without a vote of the people, however, is one percent. The tax is based on the earnings of all residents and of non-residents for work done in the municipality. Businesses may pay municipal income taxes on their net profits attributable to business in the municipality. Commuters pay income taxes in the municipality in which they work even if the municipality in which they live also levies an income tax. Though not required to do so, municipalities usually grant their residents a credit on their income taxes for the amount of income taxes paid to the municipality in which they work.[35]

The increase in tax base for the municipal income tax is estimated by summing the following items on an annual basis:

(1) increased incomes to employees in the city and county

(2) increased incomes to the city's service sector

(3) gross income to commuters from outside the county

(4) gross incomes to in-migrants to city

34/ Ohio's Taxes, 1977-78 Edition, p. 37.
35/ For more detail, see Ohio's Taxes, pp. 34-37 or ORC Chapter 718.

The gross incomes of in-migrants and commuters are used rather than net increases in their income because the perspective of this analysis is that of existing local residents. Income tax revenues are related to the increase in income earned in the municipality rather than incremental earnings to the individual. If some of the commuters simply shift jobs within the municipality, this approach will overstate the gain. This may be corrected by treating these people as local employees.

User charges, fees, and miscellaneous revenues from interest earnings, permits, fines, and penalties contributed 14.4 percent of the total municipal revenues of Ohio's cities and villages in 1976.[36/] A municipality's current per capita revenue is multiplied by the number of additional residents to approximate changes in this revenue.[37/] The number of additional residents is the product of family size per employee and the number of in-migrant employees. The user can specify both variables. The default value of family size per employee is 2.5.[38/]

Water and sewer service user charges can be estimated in the same fashion as the above fees. Alternatively, the residential and industrial use can be estimated separately in order to incorporate the effect of declining block rate schedules. If the latter approach is used, the rate schedule is applied to a typical family of 2.5 persons using 80 gallons per day and separately to the plant's consumption.

36/ Ohio Cities, 1976 Financial Report.
37/ Burchell and Listokin (pp. 192-193) suggest this approach for this class of revenues. It is also used by Battelle.
38/ U. S. Statistical Abstract, p. 11.

State aid to municipalities form an important source of local revenues. These state programs are: 1) gasoline taxes, 2) motor vehicle license fees, 3) state local government funds, 4) county undivided local government fund, 5) estate and inheritance taxes, 6) liquor and beer permits, and 7) cigarette licenses.

Three sources of information were used to determine which forms of aid to include in the model and to develop the appropriate equations and estimation procedures. These were: 1) the 1977 Annual Report of the Ohio Department of Taxation, 2) The Fiscal Impact Handbook by Burchell and Listokin, and 3) Socio-economic Effects of the DOE Gas Centrifuge Enrichment Plant (Volume 1) by Battelle, Columbus Laboratories.

This review of state formulas for the distribution of state-levied taxes revealed that only one fund is significantly affected by local growth, motor vehicle license fees. Motor vehicle fuel taxes, local government funds, estate and inheritance taxes, liquor and beer permits, and cigarette license fees may all increase but only very slightly.[39]

The most common approach for estimating additional state aid is to multiply the number of new residents times the average aid per capita in recent years. This approach, called the per capita multiplier approach, is not very accurate in Ohio.

For each form of aid, the impact of a per capita multiplier approach is compared to the estimate obtained if a state formula

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39/ See Appendix C for a review of the other state aid formulas.

is utilized. This comparison shows that for several types of aid the per capita multiplier approach can give very erroneous results.[40/] Table 7 illustrates the per capita estimates for an additional 100 families, each with three persons, moving into Athens, Ohio. In this example the per capita approach over-estimates the state aid by $2833.

Motor vehicle license fee revenues are assumed to increase in proportion to the population. This assumption is the same as assuming the ratio of each type of vehicle to the population remains the same for the new population as for the existing population.

If the municipality has permissive fees of $5.00 per vehicle, this local revenue would be added to the revenue returned by the state.[41/] Then the product of the average revenue per capita and the number of new residents is the additional revenue available to the city.

Federal aid to municipalities includes: 1) federal revenue sharing, 2) comprehensive employment and training act (CETA), and 3) community development block grants. Only the first program is a function of local growth.

Federal revenue sharing is a function of three factors: 1) local population as a proportion of the state total, 2) the area's relative tax effort, and 3) the area's relative income.

40/ The per capita multiplier approach has been used in the models available in Wisconsin, Indiana, Texas, and South Dakota. See Shaffer-Tweeten, Darling-1977, Jones, and Morse.

41/ Cities can only levy this permissive fee if the county has not adopted it.

Table 7

PER CAPITA AND FORMULA ESTIMATES
OF STATE AID TO MUNICIPALITIES[1]

Type of Aid	Per Capita Estimate	Formula Estimate
Gasoline Taxes	$802	*[2]
Motor Vehicle License Fees	1809	1809
State Local Government Funds	624	*
County Undivided Fund	445	*
Estate and Inheritance Fees	585	*
Liquor and Beer Permits	352	*
Cigarette Licenses	25	*
Total	4642	$1809

[1]Estimates are for the city of Athens assuming an additional 100 families with 3 persons per family.

[2]Less than 1 dollar.

The equation for the amount of local revenue sharing funds (R_L) available is:

$$(\text{Eq. } 4) \qquad R_L = R_S\left(\frac{P_L}{(P_L + P_R)} \times \frac{T_L}{T_S} \times \frac{Y_L}{Y_S}\right)$$

where:

R_L = federal revenue sharing funds due to a community

R_S = federal revenue sharing funds to distribute to localities in a state

P_L = local population

P_R = population in state minus P_L

T_L = local tax effort

T_S = average state tax effort

Y_L = local per capita income

Y_S = state per capita income

As the analysis in Appendix B shows, population growth will increase the local revenue proportionally. Consequently, the per capita allocation to the municipality times the number of new residents is used to estimate the change in this revenue.

This approach ignores changes which may occur in the state allocations or changes in relative incomes. It assumes that there will be no change in local tax effort due to growth and that the per capita income will be affected only slightly.[42/] The aggregate

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42/ This approach differs from that taken by Burchell and Listokin (pp. 213-214). They suggest estimating the amount of state revenues available and then using a formula similar to equation 4 to estimate the total change in local revenue attributable to growth. The Battelle study did not attempt to estimate the change in revenue sharing.

amount appropriated to each state is based on four main factors: population, urbanized population, relative tax effort, and relative income. Since this may change over time, especially the 20 years considered in the growth impact model, users may wish to omit estimates of this source of federal aid.

County Revenue Changes

Growth in employment leads to additional revenue from the following sources:

A. Local Revenues:

(1) sales taxes

(2) property taxes from the new plant's real estate

(3) property taxes from tangible personal property at the plant

(4) property taxes from housing improvements

(5) user charges, fees and miscellaneous revenues

B. State Aid:

(1) motor vehicle license fees

C. Federal Aid:

(1) revenue sharing

User charges, fees and miscellaneous revenues, motor vehicle license fees, and federal revenue sharing are handled in the same fashion as for municipalities.[43/] Property tax estimates also use the same procedures as discussed earlier in this section.

A sales tax of one-half of one percent may be assessed by counties.[44/] It may be levied on retail sales and the rental of

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43/ See Appendix B for an analysis of other forms of state aid to counties. Only minor impacts occur because of growth.

44/ Ohio's Taxes, pp. 37-38.

tangible personal property and is collected in a piggy-back fashion with the existing 4% state sales tax.

To estimate the additional local sales, the sum of the increased income to local employees and annual income of in-migrants is multiplied by the local employee's marginal propensity to consume locally. Commuters' increases in income are multiplied by a separate propensity to consume locally. The increased local expenditures are also adjusted by an income multiplier.

Estimates of the marginal propensity to consume are entered by the user. If information on this is unavailable, the default values used are .50 for local employees and .20 for commuters.[45/] The propensity to consume locally may be less in areas with a county sales tax.

School District Revenue Changes

Taxes from real, public utility, and tangible personal properties provide 89 percent of local revenues for education across Ohio. The estimation procedure for additional property tax revenues resulting from growth is discussed earlier. While the tax rate and tax reduction factor are different for the school district, the basic equation for determining property tax revenues is essentially the same one used for municipal government.

The remaining 11 percent of local revenues come from a variety of sources, including tuition from out-of-district students, interest on inactive funds, and gifts. The effect

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45/ These are rough estimates based on Osman. See Morse and Hushak, p. 23.

of growth on these revenues is not sufficiently clear enough to justify assuming any change.

In 1976 approximately 37 percent of Ohio school district revenues came from state aid and 5.5% from federal aid.[46/]

Changes in state aid for elementary and secondary education includes two basic components: 1) the basic state support and 2) categorical program funds. The categorical programs include aid to approved vocational units, approved special education units, disadvantaged pupil impact aid, and a transportation operating allowance. Approximately 60 percent of the state support in 1975 was for the basic state aid. Most of the categorical program funding is not related to growth in a systematic fashion and will not be treated here. An exception to this is transportation aid, which is included in the model.

The guaranteed yield formula became effective in the 1975-1976 school year.[47/] Generally, this formula insures a minimum level of revenue per pupil for a given number of mills for all qualifying districts. In order to qualify, a district must levy at least 20 mills for current operation expenses. This requirement may be met by summing the inside and outside operating millage for the district and the outside millage for a joint vocational school district operation. Each district must also: 1) have had a minimum number of days in the preceding school year

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46/ Ohio Schools, Financial Report to Ohio State Auditor, 1976.
47/ The Ohio Law for State Support of Public Schools, State of Ohio Department of Education, 1978.

and 2) adopt a teacher salary schedule in accordance with the Ohio Revised Code.

The objective of this formula is to compensate for differences in the level of taxable property wealth of districts throughout the state. Consequently, for any district meeting the minimum criteria, funds are guaranteed to equal at least $1300 per pupil. For each mill of the first 10 mills in excess of the minimum 20 mills which a district levies, the per pupil revenue guarantee level is increased $42.

The total state support (TSS) for elementary and secondary education is the sum of basic state support (BSS), adjustments to basic state support (A), categorical program funding (C), and other guarantees (G).

$$TSS = BSS + A + C + G$$

In this model we estimate the change in total state support based on the changes in basic state support and transportation aid.

<u>Basic state support</u> is a function of the number of children in grades K-12, the district's property valuation, and the current effective millage for operational expenses.

The formula for basic state support is:

(Eq. 5) $BSS = F_1 + F_2$

where:

(Eq. 6) $F_1 = (\$65 - LY) \times ADM \times 20$

(Eq. 7) $F_2 = (\$42. - LY) \times ADM \times (EM-20)$

where:

LY = local yield per pupil per mill

ADM = number of students in average daily attendance in the district[48/]

EM = equalized millage up to 30 mills

As equations 6 and 7 indicate, the state guarantees tha˙ state and local operating revenues per pupil in any qualifying school district in Ohio will be at least $1300 (20 x $65) plus aı additional $42 for each mill above 20 up to a maximum of 10 additional mills. The State's share of this amount depends on the revenue-generating ability per mill of property in the local district. The local yield per pupil per mill (LY) is:

(Eq. 8) LY = (EV/ADM)/1000

where:

EV = equalized valuation of property in the district

ADM = number of students in average daily membership in the district

Equalized valuation of property (EV) is simply the taxable value of all real, tangible personal, and public utility property subject to taxation in the school district.[49/] Though the taxable value of real property changes only once every three years, equalized valuation figures are adjusted to reflect the estimated change annually.

48/ This is computed by adding "one-half the kindergarten ADM, the ADM of grades 1-12 and part-time pupils, academic full-time equivalency of pupils enrolled in an approved vocational unit and 25 percent of the pupils attending a JVS or a contract vocational school." (Walter, pp. 4 and 5)

49/ See Section 3317.021 ORC

Equalized millage (EM) may be determined by dividing the total taxes charged and payable by the equalized valuation.[50] Though it is not part of the legal definition, it is useful to regard equalized millage as having an upper limit of 30. As the law is written, a school district's guaranteed minimum revenue per pupil stops rising at 30 mills. In the actual computation of basic state support, the State regards equalized millage in this manner. If a school district's equalized millage is less than it was in either of the previous two years, the highest figure may be used.

Growth in employment may result in changes in the number of students and the equalized valuation of property in a school district, which in turn affect the local yield per pupil per mill. Changes in state aid can be calculated by using data in equations 6 and 7 with and without growth.

Estimates for F_1 and F_2 are available for the school district for the first year without the growth base. Later years present a problem since growth or decline exogenous to the development being studied may result in different levels of basic state support. This situation is handled by the following approach. First, the student enrollment is projected to increase or decrease, independent of the plant under consideration, by a constant rate over the entire period (see equation 49 in Appendix A). Next, the enrollment with growth is estimated by adding the number of new

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50/ See Section 3317.02 ORC

students entering the system due to the plant to the estimate without growth (equation 50, Appendix A). Equation 51 in Appendix A provides estimates of the tax base without the new firm. Equation 52 adds the new firm's real property and tangible property and the value of new homes or housing improvements.

Estimates of the equalized millage without and with the new plant may be derived from equations 53 and 54, respectively. In a simplified form, they are:

(Eq. 9) EM (i, T) = LTRi/EV(i,T)

where:

EM(i,T) = equalized millage

LTRi = local property tax revenues

EV = equalized valuation

T = year

i = 1 with the new plant; 2 without it

Growth may increase, decrease, or leave unchanged the local yield per pupil per mill (LY = (EV/ADM)/1000). If the value of the new plant and homes/student equal the district average, then no change occurs in LY. If the ratio of property values to students from the growth is higher than the existing average, the local yield will increase. Given a constant equalized millage rate, as local yield per pupil per mill rises, state aid declines.

In summary, equations 49, 51, and 53 in Appendix A provide without estimates for student enrollment, property values in the district, and equalized millage. Equations 50, 52, and 54 provide the estimate with the addition or expansion of a new plant.

Equation 63 provides an estimate for the total change in state aid to the district.

Guarantee provisions are also included in the state school aid system. The purpose of these "no-loss" or "save-harmless" guarantee provisions is to prevent school districts from experiencing a decrease in state support due to circumstances such as real property reappraisals or declining enrollments. Under this type of arrangement, the state guarantees each school district that its total state aid will be at least as much in a given year as it was the year before. Recently, these guarantees have been expanded to insure a certain percentage increase in each district's state aid from one year to the next. Further, these assurances are made without regard to a district's entitlement under the guaranteed-yield formula. The effect is that the formula is being circumvented increasingly by a funding system which may be completely unrelated to need, merit, or local tax effort.

This model considers the effect of such guarantees and allows the user to select the percentage by which the school district's state support will be insured to rise. A default value of 7% will be used, if none is selected. This default value reflects recent tendencies of the Ohio legislature.

Transportation aid for elementary and secondary schools is provided by Ohio in addition to the basic state support.[51/]

51/ For details see "Standard for the Calculation of Pupil Transportation Operation Payment," Ohio Department of Education, Columbus, Ohio (effective January 1978 for 1977-78 and 1978-79).

To be eligible for this form of state aid, the district must qualify for the school foundation funding.

The amount of the transportation subsidy is a function of the number of eligible pupils or the amount of approved total annual mileage. The payment also varies with the type of vehicle and ownership of the vehicle. For example, a school board owned and operated bus receives a payment of \$39 while a public transit bus receives \$60.

All students are "eligible" if they live one mile or more from the school. Essentially all school-related transportation, within the county, is "approved" mileage.

Growth in a district will increase the state aid for transportation. The amount of additional aid depends on the size of the district, the geographical distribution of the students and the type of transportation provided. As a default value the average transportation aid per pupil is used. This will reflect the current influence of these variables on the total aid. If additional information is available locally, the user can adjust this estimate.

Transportation aid is estimated as a portion of equation 67 in the following manner:

(Eq. 10) $$TA = \frac{TRANS(1xINFLAT(3)(T-1)}{H(11)} \times H(9)$$

where:

TA = transportation aid from the state

TRANS = total current transportation to school district

INFLAT(3) = average annual rate of inflation

$H(11)$ = average daily enrollment in year 1 if plant does not locate

$H(9)$ = number of new students

Bus purchase allowance from the state depends on the wealth of the district. The formula used to estimate this state aid is:

(Eq. 11) Bus Purchase Allowance = $R \times P \times B$

where:

R = reimbursement factor

P = average purchase price of buses

B = number of new buses

It is assumed that P = $14,236 for a 66-passenger bus in 1976-77. The number of buses needed is related to the average number of students per bus currently in the system.52/

The ratio is:

$X = ADM/Bd$

where:

ADM = Average Daily Membership in the district in most recent year

Bd = number of buses owned by the district

If the number of new students (SN) is equal to or greater than this ratio (X), then a new bus is assumed to be purchased. The procedure used is:

If $X > SN$, then $B = 0$

If $X \leq SN, < 2X$, then $B = 1$

If $2X \leq SN < 3X$, then $B = 2$, etc.

52/ This section follows Battelle's approach for the bus purchase allowance (pp. 242-244).

Federal aid programs for elementary and secondary education which change systematically with local growth are: 1) federal aid for school lunches and 2) the federal impact district aid (PL81-874). The latter only applies to districts with large federal projects and are not considered in this circular.

To estimate changes in federal school lunch aid, it is assumed that the per student aid previously received will continue. This implies that new students come from families with similar incomes and size as the current population.53/

Public Expenditure Estimation for Ohio's Local Governments

The procedures used in this model making the initial estimates are described in this section. As illustrated in the discussion of alternative expenditure estimation procedures, in-depth case studies may be justified for some decisions. The use of several estimation procedures may also be desirable.

The computerized model enters expenditures on a per capita basis. This approach is used to facilitate sensitivity analysis of firm size and tax abatements. If another estimation procedure is desirable, the total annual change in expenditure should be estimated. The total annual change should then be divided by the number of new residents in the city or county to create the values for the computer program.

Municipal Service Expenditures

Municipal expenditure data are reported to the Ohio Auditor

53/ Battelle used a similar approach, p. 245.

by the city or village clerk in a copy of "Report of Receipts and Expenditures" (Form 162). Data two years older can be obtained from the Ohio Cities Financial Report or Ohio Villages Financial Report published by the State Auditor's office. The service-safety director is also a good source of data in a city.

For controversial services it is recommended that several estimation procedures be used to give added perspective to the users. In the following discussion specific suggestions are offered for each service.

Police and fire protection expenditure changes are estimated initially using cross-sectional analysis. If more detail is needed, department officials are contacted for information relating solely to the industrial or commercial plant. Residential growth is handled by using either the community standards approach or the comparable cities approach.

This is illustrated for a firm moving to Athens, Ohio and employing 150 employees. The community has a population of approximately 18,000 and has declined slightly so the appropriate regression coefficient is 0.0000162.[54] It's assumed only 20 percent of the employees are in-migrants and they have a family averaging 3.5 persons per worker for 105 new residents. With expenditures per capita for police of $22 and for fire protection of $30, the total change would be:

54/ From Burchell and Listokin, p. 141.

(Eq. 12) $\Delta E = (R + (I \times C \times P))\ Ep$

where: ΔE is additional expenditures, R is new residents, I is the in-migrant jobs, C is the Burchell and Listokin regression coefficient, P is the city's population, and Ep is the current expenditure per capita for the service.

For example, additional fire and police expenditures for Athens would be:

(Eq. 13) $\text{Fire Expenditures} = (105 \times (30 \times .0000168 \times 18{,}000)) \times \$30 = \$3422$

(Eq. 14) $\text{Police Expenditures} = (105 \times (30 \times .0000168 \times 18{,}000)) \times \$22 = \$2509$

A second approach considers only the residential component of this growth, using community service standards. The North Central Region averages 1.72 police and 0.93 fire fighters per 1000 population. At 18,000 population, Athens' "desired" level of police and fire employment would be 30.9 (1.72 x 18) and 16.7 (0.93 x 18), respectively. Counting both Ohio University's security personnel and the local police force, there are 46 police officers or an excess capacity of 15. The additional 30 new employees, or 105 residents, would need less than one additional police worker. So, no additional expenses would be predicted by this approach.

Alternatively, it can be assumed that no excess capacity ever exists in these services. Rather, if a higher than average number of employees exists, it is interpreted as simply reflecting unusual local circumstances (e.g. a university). Then the additional 105 persons are assumed to need an additional .11 police workers ((105 ÷ 1000) * 1.72). The annual cost per employee is estimated from current budgeted data to be $15,000 resulting in additional costs of $1650. As these three estimates show, additional costs for police could range from zero to $2495 depending on the assumptions.

The Athens fire department currently has 23 employees or an excess capacity of 6.3 according to the North Central standards. The additional 105 residents would require less than one additional worker, so that no additional expenses are predicted by the first set of assumptions. Using the assumption that no excess capacity exists due to unusual circumstances, there would be a need for an additional .10 ((105 ÷ 1000) * .93) persons. At an annual cost of approximately $17,500 per fire worker, this results in an increase of $1750 if part-time employees can be added or $17,500 if an extra full-time employee must be hired.

Water and sewer service expenditure changes are frequently influenced by excess capacity. Department heads should be contacted for information on: 1) the water and sewer treatment plant's daily capacity, 2) the average daily usage or percent of capacity utilized, and 3) the peak daily usage demand and percent of excess capacity under peak loads. The demand for water by the new plant and new residents should be estimated separately.[55]

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[55] The latter can be estimated as 80 gallons/day per person.

If no excess or deficient capacity exists, then the initial approximation can be made using the cross-sectional regression coefficients from Burchell and Listokin. For example, for water and sewer the increases are:

(Eq. 15) Water = (105 x (30 x .000029 x 18,000)) * 9.64 = $1163

(Eq. 16) Sewer = (105 x (30 x .000029 x 18,000)) x 4.61 = $556

If excess capacity is sufficient to handle the growth, only operational expenses need to be considered. This is done by determining the operational and maintenance cost per 1000 gallons of water and sewerage. This is multiplied by the expanded consumption (which is estimated here by assuming that each new person consumes 80 gallons/day). Additional consumption must be considered for the firm. For example, in Athens in 1977 the operational cost per 1000 gallons was:

Operational Cost per 1000 gallons = Operational Costs ÷ Thousands of Gallons

Water: O&M/1000 = $192,833 per year ÷ 839,500 thousand gallons = 0.23-thousand

Sewer: O&M/1000 = $92,245 ÷ 1,168,000 thousand gallons 0.08/thousand

To estimate additional residential consumption, we use:

(Eq. 17) Additional Residential Consumption = New Residents gal/day x $365
= 105 x 80 x 365 = 3,066 thousand gallons

Individual estimates must be made for each firm.

(Eq. 18) Additional Operational Costs = Operational Costs per 1000 Gallons x Additional Consumption

For example, the residential use for water and sewer will increase annual operational costs by $705 and $245, respectively.

Other municipal expenditures include highway construction and maintenance, financial administration, general control, parks and recreation, and libraries. These can all be handled by the cross-sectional analysis. As a check on this approach, the city's service/safety director may be consulted.

County Service Expenditures

County expenditure estimates are not considered in the same detail as municipal expenditures because the necessary data and coefficients are not yet available for using the community service standards, cross-sectional analysis or comparable city methods. The expenditure per capita and proportional valuation estimation procedures cannot provide detailed estimates by service.

The expenditure per capita approach is used to estimate additional county expenditures. As a check on this approach county officials can also be asked to indicate special changes in services which might be required.

The first year change in expenditures will be illustrated for a firm employing 150 employees in Athens County. The following data are available for 1976:

County Population - 50,200

Expenditures General Fund - $1,184,550

Non-Residential Real Property - $62,694,100

Total Real Property - $179,126,755

Ratio Non-Residential/Total - 0.35

To separate the residential and non-residential expenditures it is assumed that these expenditures are proportional to the assessed valuation in each category. For example, for Athens

County in 1976 this would give residential expenditures from the general fund of $769,958.[56/] Expenditures per capita for residential services are then $15.34 ($769,958 ÷ 50,200).

Additional expenditures from a firm adding 150 employees with 20 being in-migrants with 2.5 persons per family would be:

(Eq. 19) $$\text{Additional County Expenditures} = \text{Jobs} \times \frac{\text{Residents}}{\text{Job}} \times \frac{\text{Expenditures}}{\text{Person}}$$

$$= 20 \times 2.5 \times \$15.34$$

$$= \$767$$

School District Expenditures

School expenditure estimates can be divided into annual operational expenditures and annual capital expenditures. Two standard estimation methods can be used for school districts' operating costs: 1) the per capita expenditure approach and 2) community service standards. The first two are illustrated for the Athens City School District using the firm with 150 new employees and 1976 data on school districts.

The per capita expenditure formula is:

(Eq. 20) $$\text{Additional School Expenditures} = \frac{\text{Current Expenditures}}{\text{Students}} * \frac{\text{New Students}}{\text{Employees}} * \text{New Employees}$$

There was an average of .46 students per employee in Ohio in 1976 and this is used as a default value. This means the additional expenditures would be estimated as: Additional Expenditures = $1492 * .46 * 150 = $102,948.

[56/] (1.-.35) (1,184,550) = $769,958.

This value provides the first annual expenditure estimate of the analysis. A user selected inflation rate is then applied to these costs to estimate further changes.

The equation for the community services approach is:

(Eq. 21) Additional School Expenditures = Average Cost Per Employee *

$$\frac{\text{New Students}}{\text{Employee}} * \text{New Employees} * .074$$

The coefficient .074 indicates that there are 74 additional persons employed for each additional 1000 students.[57/] Using the Athens City Schools example, the increased expenditures are estimated to be:

Additional Expenditures = $32,380 x .46 * .150 * .074 = $165,332

The second estimate $165,332 is sixty-one percent higher than the first $102,948. If there is excess capacity in the schools, the opinions of the local school officials may provide insights on these estimates.

The three major factors in capital costs are: 1) classrooms, 2) classroom equipment, and 3) buses. The approach used to estimate changes in these costs is based on data reported by Battelle in 1978.[58/]

57/ These coefficients come from Burchell and Listokin, p. 74. The Battelle report uses a similar approach for instructional salaries with a standard of 25 pupils per teacher or 40 teachers per 1000 pupils. Then other costs were included by using a detailed per capita approach for each function. They assumed that there would be no increased costs for dental inspections, nurses, library staff, playground staff, cooks. All others are increased via the per capita approach.

58/ Battelle, pp. 255 and 256.

The number of additional classrooms and buses are found by dividing the number of new students by 25 and 66, respectively.[59]

Then the total capital outlay is:

(Eq. 22) $$\text{Total Additional Capital Outlay} = (B * \$14{,}236 + C * \$29{,}700)(1 + r)$$

where:

B = number of new buses needed

C = number of new classrooms needed

r = percentage change in prices since 1977

For the Athens example, the 150 new employees would add 69 students (150 * .46), 2.76 new classrooms (69 ÷ 25) and 1.04 new buses (69 ÷ 66). Assuming three new classrooms and one bus are actually added and that these costs had increased by 12 percent since 1977, the increased costs would be:

(Eq. 23) $$\text{Total Additional Capital Costs} = [(1 \times \$14{,}236) + (3 \times \$29{,}700)] * (1.12) = \$115{,}736$$

The annual costs at nine percent interest for 30 years is:

(Eq. 24) $$\text{Annual Capital Costs} = .097336 * \$115{,}736 = \$11{,}265$$

The expenditure estimation procedures outlined here provide approximations of the marginal costs induced by growth. It is generally prudent to explore several alternative sets of assumptions on these costs. If possible, use partial budgeting or an engineering-economics approach to those services which are of most concern.[60]

59/ If the district has excess capacity in either facility, this procedure over estimates the required expansion.

60/ For an example of this, see Morse-1978.

Appendix A

Ohio Economic Growth Impact Model--The Equations

Section I: Private Sector Income Equations

1. $D(1,1,T) = WAGES \times JEMP \times (1-LF(1)) \times [(1 + INFLAT(1))^{T-1}]$

D(1,1,T) = Increased annual gross income in year T to employees residing in the city
WAGES = Annual gross wages per hourly employee in the plant
JEMP = Number of employees residing in the city initially
LF(1) = Income leakage factor in the city
INFLAT(1) = Annual rate of change in wages
T = Time variable, which equals 1 in the first year, 2 in the second year, and so on.

2. $D(2,1,T) = D(1,1,T) \times YP$

D(2,1,T) = Increased annual take-home income in year T to employees residing in the city
D(1,1,T) = See equation 1
YP = Ratio of net income to gross income

3. $D(3,1,T) = D(2,1,T)/[(1 + INFLAT(3))^{T-1}]$

D(3,1,T) = Increased annual take-home income in year T to employees residing in the city in constant dollars
D(2,1,T) = See equation 2
INFLAT(3) = Annual rate of change in the overall price level
T = See equation 1

4. $E(1) = \sum\{D(3,1,T)/[(1 + RATE)^{T}]\}$

E(1) = Present value of increased annual take-home income to employees residing in the city
D(3,1,T) = See equation 3
RATE = Annual rate of discount
T = See equation 1

5. $D(1,2,T) = WAGES \times KEMP \times (1 - LF(2)) \times [(1 + INFLAT(1))^{T-1}]$

D(1,2,T) = Increased annual gross income in year T to employees residing in the balance of the county
WAGES = See equation 1
KEMP = Number of employees residing in the balance of the county initially
LF(2) = Income leakage factor in the county
INFLAT(1) = See equation 1
T = See equation 1

6. $D(2,2,T) = D(1,2,T) \times YP$

$D(2,2,T)$ = Increased annual take-home income in year T to employees residing in the balance of the county
$D(1,2,T)$ = See equation 5
YP = See equation 2

7. $D(3,2,T) = D(2,2,T)/[(1 + INFLAT(3))^{T-1}]$

$D(3,2,T)$ = Increased annual take-home income in year T to employees residing in the balance of the county in constant dollars
$D(2,2,T)$ = See equation 6
$INFLAT(3)$ = See equation 3
T = See equation 1

8. $E(2) = \sum \{D(3,2,T)/[1 + RATE)^{T}]\}$

$E(2)$ = Present value of increased annual take-home income to employees residing in the balance of the county
$D(3,2,T)$ = See equation 7
$RATE$ = See equation 4
T = See equation 1

9. $INS(T) = B(4) \times LEMP1 \times [(1 + INFLAT(1))^{T-1}]$

$INS(T)$ = Annual gross income in year T of employees migrating into the city
$B(4)$ = Annual gross wages per salaried employee in the plant
$LEMP1$ = Number of employees migrating into the city
$INFLAT(1)$ = See equation 1
T = See equation 1

10. $B(6) = 1/\left(1-\{[(A(1) + A(3)) \times B(1)] + [(A(2) + A(4)) \times B(3)] + (A(5) \times B(7))\}\right)$

$B(6)$ = Income multiplier
$A(1)$ = Percent of employees residing in the city initially
$A(3)$ = Percent of employees migrating into the city
$B(1)$ = Marginal propensity to consume in city by city residents
$A(2)$ = Percent of employees residing in the balance of the county initially
$A(4)$ = Percent of employees migrating into the balance of the county
$B(3)$ = Marginal propensity to consume in the city by county residents
$A(5)$ = Percent of employees commuting to work from outside of the county
$B(7)$ = Marginal propensity to consume in the city by commuters

11. $B6(T) = B(6) - \{[(B(6)-1)/25] \times (T-6)^2\}$
If $T > 6$, then $B6(T) = B6(6)$

B6(T) = Income multiplier in year T, to be phased in over the first six years
B(6) = See equation 10
T = See equation 1

12. $C(3) = (D(1,1,T) + INS(T)) \times B(1) \times B(2) \times B6(T)$

C(3) = Value added in year T by the additional expenditures of employees residing in the city
D(1,1,T) = See equation 1
INS(T) = See equation 9
B(1) = See equation 10
B(2) = Ratio of value added to sales
B6(T) = See equation 11

13. $INC(T) = B(4) \times LEMP2 \times [(1 + INFLAT(1))^{T-1}]$

INC(T) = Annual gross income in year T of employees migrating into the county
B(4) = See equation 9
LEMP2 = Number of employees migrating into the county
INFLAT(1) = See equation 1
T = See equation 1

14. $C(4) = (D(1,2,T) + INC(T)) \times B(3) \times B(2) \times B6(T)$

C(4) = Value added in year T by the additional expenditures of employees residing in the balance of the county
D(1,2,T) = See equation 5
INC(T) = See equation 13
B(3) = See equation 10
B(2) = See equation 12
B6(T) = See equation 11

15. $F(T) = WAGES \times MEMP \times [(1 + INFLAT(1))^{T-1}]$

F(T) = Annual gross income in year T of employees commuting from outside of the county
WAGES = See equation 1
MEMP = Number of employees commuting from outside of the county
INFLAT(1) = See equation 1
T = See equation 1

16. $C(5) = F(T) \times B(7) \times B(2) \times B6(T)$

$C(5)$ = Value added in year T by the additional expenditures of employees commuting from outside of the county
$F(T)$ = See equation 15
$B(7)$ = See equation 10
$B(2)$ = See equation 12
$B6(T)$ = See equation 11

17. $D(1,3,T) = C(3) + C(4) + C(5)$

$D(1,3,T)$ = Increased annual gross income in year T to service sector in the city from expanded consumption
$C(3)$ = See equation 12
$C(4)$ = See equation 14
$C(5)$ = See equation 16

18. $D(2,3,T) = D(1,3,T) \times YP$

$D(2,3,T)$ = Increased annual take-home income in year T to service sector in the city from expanded consumption
$D(1,3,T)$ = See equation 17
YP = See equation 2

19. $D(3,3,T) = D(2,3,T)/[(1 + INFLAT(3))^{T-1}]$

$D(3,3,T)$ = Increased annual take-home income in year T to service sector in the city from expanded consumption in constant dollars
$D(2,3,T)$ = See equation 18
$INFLAT(3)$ = See equation 3
T = See equation 1

20. $E(3) = \Sigma \{D(3,3,T)/[(1 + RATE)^{T}]\}$

$E(3)$ = Present value of increased annual take-home income to service sector in the city from expanded consumption
$D(3,3,T)$ = See equation 19
$RATE$ = See equation 4
T = See equation 1

Section II: Public Sector Impact Equations

21. $G(1,1,T) = H(1) \times \{1-[DR \times (T-1)]\} \times TAXAB(T) \times 0.0035 \times [TAX(4) \times M(1,T) + TAX(1) \times (1 - TRF(1))]$

$G(1,1,1) = 0$

$G(1,1,T) = G[1,1,(T-1)]$

G(1,1,T) = Additional real property tax revenues for the city in year T from the plant
H(1) = Market value of improvements to the plant site in year 1
DR = Annual rate of depreciation on improvements to the plant site
T = See equation 1
TAXAB(T) = Dummy variable which equals 0 if a tax abatement is granted and 1 if an abatement is not granted
TAX(4) = Inside millage for the city in year 1
M(1,T) = Index of change in the value of property from year 1 to year T, adjusted to reflect change only once every three years
TAX(1) = Outside millage for the city in year 1
TRF(1) = Tax reduction factor for real property in the city in year 1

22. $G(2,1,T) = 0.00035 \times H(2) \times HH(T) \times M(2,T) \times (TAX(4) + \{[TAX(1) \times (1 - TRF(1))] / M(3,T)\})$

$G(2,1,1) = 0$

$G(2,1,T) = G[2,1(T-1)]$

G(2,1,T) = Additional real property tax revenues for the city in year T from new or improved homes
H(2) = Ratio of house values to annual gross incomes
HH(T) = Percent of new or improved homes in the city in year T lying outside abated area, equals 1 in years when abatement does not apply
M(2,T) = Sumation of increased annual gross income in year T to employees residing in the city, adjusted to change only once every three years
TAX(4) = See equation 21
TAX(1) = See equation 21
TRF(1) = See equation 21
M(3,T) = Index of change in the overall price level from year 1 to year T, adjusted to reflect change only once every three years

23. $G(3,1,T) = LEMP1 \times H(4) \times REV(1) \times [(1 + INFLAT(3))^{T-1}]$

G(3,1,T) = Additional revenues for the city from miscellaneous sources in year T
LEMP1 = See equation 9
H(4) = Family size per employee
REV(1) = Miscellaneous city revenues per capita in year 1
INFLAT(3) = See equation 3
T = See equation 1

24. $G(4,1,T) = (D(1,1,T) + D(1,2,T) + F(T) + INS(T) + INC(T) + D(1,3,T)) \times H(7)$

$G(4,1,T)$ = Additional income tax revenues for the city from employee wages in year T
$D(1,1,T)$ = See equation 1
$D(1,2,T)$ = See equation 5
$F(T)$ = See equation 15
$INS(T)$ = See equation 9
$INC(T)$ = See equation 13
$D(1,3,T)$ = See equation 17
$H(7)$ = Municipal income tax rate

25. $G(5,1,T) = G(5,1,1) \times (1 + INFLAT(3)^{T-1})$

$G(5,1,T)$ = Additional income tax revenues for the city from company profits in year T
$INFLAT(3)$ = See equation 3
T = See equation 1

26. $G(8,1,T) = H(10) \times (TAX(4) + TAX(1)) \times ART(T) \times 0.001 \times [(1 + INFLAT(2))^{T-1}]$

$G(8,1,T)$ = Additional tangible personal property tax revenues for the city in year T from the plant
$H(10)$ = Market value of tangible personal property associated with the plant in year 1
$TAX(4)$ = See equation 21
$TAX(1)$ = See equation 21
$ART(T)$ = Assessment ratio for tangible personal property in year T
$INFLAT(2)$ = Annual rate of change in property values
T = See equation 1

27. $SA(T,1) = SAPC(1) \times LEMP1 \times H(4) \times [(1 + INFLAT(3))^{T-1}]$

$SA(T,1)$ = Additional state and federal aid to the city in year T as a result of new residents
$SAPC(1)$ = State and federal aid to the city in year 1 on a per capita basis
$LEMP1$ = See equation 9
$H(4)$ = See equation 23
$INFLAT(3)$ = See equation 3
T = See equation 1

28. $D(1,4,T) = G(1,1,T) + G(2,1,T) + G(3,1,T) + G(4,1,T) + G(5,1,T) + G(8,1,T) + SA(T,1)$

$D(1,4,T)$ = Additional revenues received by the city in year T as a result of the plant
$G(1,1,T)$ = See equation 21
$G(2,1,T)$ = See equation 22
$G(3,1,T)$ = See equation 23
$G(4,1,T)$ = See equation 24
$G(5,1,T)$ = See equation 25
$G(8,1,T)$ = See equation 26
$SA(T,1)$ = See equation 27

29. POLICE = MS(1) x LEMP1 x H(4)
FIRE = MS(2) x LEMP1 x H(4)
WATER = MS(3) x LEMP1 x H(4)
SEWER = MS(4) x LEMP1 x H(4)
STREET = MS(5) x LEMP1 x H(4)
OTHER = MS(6) x LEMP1 x H(4)

POLICE = Additional operating expense of city police department in year 1 due to new residents
FIRE = Additional operating expense of city fire department in year 1 due to new residents
WATER = Additional operating expense of city water department in year 1 due to new residents
SEWER = Additional operating expense of city sewer department in year 1 due to new residents
STREET = Additional operating expense of city street department in year 1 due to new residents
OTHER = Additional operating expense of all other city departments in year 1 due to new residents
MS(1) = Operating expense of city police department in year 1 on a per capita basis
MS(2) = Operating expense of city fire department in year 1 on a per capita basis
MS(3) = Operating expense of city water department in year 1 on a per capita basis
MS(4) = Operating expense of city sewer department in year 1 on a per capita basis
MS(5) = Operating expense of city street department in year 1 on a per capita basis
MS(6) = Operating expense of all other city departments in year 1 on a per capita basis
LEMP1 = See equation 9
H(4) = See equation 23

30. $G(6,1,T) = (POLICE + FIRE + WATER + SEWER + STREET + OTHER) \times [(1 + INFLAT(3))^{T-1}]$

G(6,1,T) = Additional operating expense of city services in year T due to new residents
POLICE = See equation 29
FIRE = See equation 29
WATER = See equation 29
SEWER = See equation 29
STREET = See equation 29
OTHER = See equation 29
INFLAT(3) = See equation 3
T = See equation 1

31. $D(2,4,T) = G(6,1,T) + SITE(T,1)$

$D(2,4,T)$ = Additional expense to the city in year T due to the plant
$G(6,1,T)$ = See equation 30
$SITE(T,1)$ = Additional annual capital expense to the city in year T, including site development

32. $D(3,4,T) = (D(1,4,T) - D(2,4,T))/[(1 + INFLAT(3))^{T-1}]$

$D(3,4,T)$ = Net impact of the plant on the city in year T in constant dollars
$D(1,4,T)$ = See equation 28
$D(2,4,T)$ = See equation 31
$INFLAT(3)$ = See equation 3
T = See equation 1

33. $E(4) = \sum\{D(3,4,T)/[(1 + RATE)^T]\}$

$E(4)$ = Present value of the net impact of the plant on the city
$D(3,4,T)$ = See equation 32
RATE = See equation 4
T = See equation 1

34. $G(1,2,T) = H(1) \times \{1 - [DR \times (T-1)]\} \times TAXAB(T) \times 0.00035 \times [TAX(5) \times M(1,T) + TAX(2) \times (1 - TRF(2))]$
$G(1,2,1) = 0$
$G(1,2,T) = G[1,2,(T-1)]$

$G(1,2,T)$ = Additional real property tax revenues for the county in year T from the plant
$H(1)$ = See equation 21
DR = See equation 21
T = See equation 1
$TAXAB(T)$ = See equation 21
$TAX(5)$ = Inside millage for the county in year 1
$M(1,T)$ = See equation 21
$TAX(2)$ = Outside millage for the county in year 1
$TRF(2)$ = Tax reduction factor for real property in the county in year 1

35. $G(2,2,T) = 0.00035 \times H(2) \times HC(T) \times M(4,T) \times \left(TAX(5) + \left\{[TAX(2) \times (1 - TRF(2))]/M(3,T)\right\}\right)$

$G(2,2,1) = 0$

$G(2,2,T) = G[2,2(T-1)]$

G(2,2,T) = Additional real property tax revenues for the county in year T from new or improved homes
H(2) = See equation 22
HC(T) = Percent of new or improved homes in the county in year T lying outside abated area, equals 1 in years when abatement does not apply
M(4,T) = Sumation of increased annual gross income in year T to employees residing in the county, adjusted to change only once every three years
TAX(5) = See equation 34
TAX(2) = See equation 34
TRF(2) = See equation 34
M(3,T) = See equation 22

36. $G(3,2,T) = LEMP \times H(4) \times REV(2) \times [(1 + INFLAT(3))^{T-1}]$

G(3,2,T) = Additional revenues for the county from miscellaneous sources in year T
LEMP = Number of employees migrating into the city and county
H(4) = See equation 23
REV(2) = Miscellaneous county revenues per capita in year 1
INFLAT(3) = See equation 3
T = See equation 1

37. $G(4,2,T) = \left\{[(D(1,1,T) + INS(T)) \times B(8)] + [(D(1,2,T) + INC(T)) \times B(9)] + (F(T) \times B(10))\right\} \times B6(T) \times H(5)$

G(4,2,T) = Additional sales tax revenues in year T for the county
D(1,1,T) = See equation 1
INS(T) = See equation 9
B(8) = Marginal propensity to consume in the county by city residents
D(1,2,T) = See equation 5
INC(T) = See equation 13
B(9) = Marginal propensity to consume in the county by county residents
F(T) = See equation 15
B(10) = Marginal propensity to consume in the county by commuters
B6(T) = See equation 11
H(5) = County sales tax rate

38. $G(8,2,T) = H(10) \times (TAX(5) + TAX(2)) \times ART(T) \times 0.001 \times [(1 + INFLAT(2))^{T-1}]$

G(8,2,T) = Additional tangible personal property tax revenues for the county in year T from the plant
H(10) = See equation 26
TAX(5) = See equation 34
TAX(2) = See equation 34
ART(T) = See equation 26
INFLAT(2) = See equation 26
T = See equation 1

39. $SA(T,2) = SAPC(2) \times LEMP \times H(4) \times [(1 + INFLAT(3))^{T-1}]$

SA(T,2) = Additional state and federal aid to the county in year T as a result of new residents
SAPC(2) = State and federal aid to the county in year 1 on a per capita basis
LEMP = See equation 36
H(4) = See equation 24
INFLAT(3) = See equation 3
T - See equation 1

40. $D(1,5,T) = G(1,2,T) + G(2,2,T) + G(3,2,T) + G(4,2,T) + G(8,2,T) + SA(T,2)$

D(1,5,T) = Additional revenues received by the county in year T as a result of the plant
G(1,2,T) = See equation 34
G(2,2,T) = See equation 35
G(3,2,T) = See equation 36
G(4,2,T) = See equation 37
G(8,2,T) = See equation 38
SA(T,2) = See equation 39

41. $G(6,2,T) = P(1) \times [(1 + P(3))^{T-1}] \times LEMP \times H(4)$

G(6,2,T) = Additional operating expense of county services in year T due to new residents
P(1) = Operating expense of all county services in year 1 on a per capita basis
P(3) = Annual rate of change in county expenditures per capita
T = See equation 1
LEMP = See equation 36
H(4) = See equation 24

42. $D(2,5,T) = G(6,2,T) + SITE(T,2)$

D(2,5,T) = Additional expense to the county in year T due to the plant
G(6,2,T) = See equation 41
SITE(T,2) = Additional annual capital expense to the county in year T, including site development

43. $D(3,5,T) = (D(1,5,T) - D(2,5,T))/[(1 + INFLAT(3))^{T-1}]$

$D(3,5,T)$ = Net impact of the plant on the county in year T in constant dollars
$D(1,5,T)$ = See equation 40
$D(2,5,T)$ = See equation 42
$INFLAT(3)$ = See equation 3
T = See equation 1

44. $E(5) = \sum\{D(3,5,T)/[(1 + RATE)^T]\}$

$E(5)$ = Present value of the net impact of the plant on the county
$D(3,5,T)$ = See equation 43
$RATE$ = See equation 4
T = See equation 1

45. $G(1,3,T) = H(1) \times \{1 - [DR \times (T-1)]\} \times TAXAB(T) \times 0.00035 \times [TAX(6) \times M(1,T) + TAX(3) \times (1 - TRF3(1,T))]$
$G(1,3,1) = 0$
$G(1,3,T) = G[1,3,(T-1)]$

$G(1,3,T)$ = Additional real property tax revenues for the school district in year T from the plant
$H(1)$ = See equation 21
DR = See equation 21
T = See equation 1
$TAXAB(T)$ = See equation 21
$TAX(6)$ = Inside millage for the school district in year 1
$M(1,T)$ = See equation 21
$TAX(3)$ = Outside millage for the school district in year 1
$TRF3(1,T)$ = Tax reduction factor for real property in the school district in year T with the plant, adjusted to prevent the effective millage rate from dropping below 20

46. $G(2,3,T) = 0.00035 \times H(2) \times HC(T) \times M(4,T) \times \left(TAX(6) + \{[TAX(3) \times (1 - TRF3(1,T))]/M(3,T)\}\right)$
$G(2,3,1) = 0$
$G(2,3,T) = G[2,3,(T-1)]$

$G(2,3,T)$ = Additional real property tax revenues for the school district in year T from new or improved homes
$H(2)$ = See equation 22
$HC(T)$ = See equation 35
$M(4,T)$ = See equation 35
$TAX(6)$ = See equation 45
$TAX(3)$ = See equation 45
$TRF3(1,T)$ = See equation 45
$M(3,T)$ = See equation 22

47. $G(3,3,T) = H(9) \times REV(3) \times [(1 + INFLAT(3))^{T-1}]$

$G(3,3,T)$ = Additional revenues for the school district from miscellaneous sources in year T
$H(9)$ = Number of new students in year T due to the plant
$REV(3)$ = Miscellaneous school district revenues per student in year 1
$INFLAT(3)$ = See equation 3
T = See equation 1

48. $G(8,3,T) = H(10) \times (TAX(6) + TAX(3)) \times ART(T) \times 0.001 \times [(1 + INFLAT(2))^{T-1}]$

$G(8,3,T)$ = Additional tangible personal property tax revenues for the school district in year T from the plant
$H(10)$ = See equation 26
$TAX(6)$ = See equation 45
$TAX(3)$ = See equation 45
$ART(T)$ = See equation 26
$INFLAT(2)$ = See equation 26
T = See equation 1

49. $ADM(2,T) = H(11) \times [(1 + SE)^{T-1}]$

$ADM(2,T)$ = Average daily enrollment in year T without the plant
$H(11)$ = Average daily enrollment in year 1 without the plant
SE = Annual rate of change in enrollment without the plant
T = See equation 1

50. $ADM(1,T) = ADM(2,T) + H(9)$

$ADM(1,T)$ = Average daily enrollment in year T with the plant
$ADM(2,T)$ = See equation 49
$H(9)$ = See equation 47

51. $EV(2,T) = [H(12) + (H(13) \times ART(T)) + H(6)] \times [(1 + INFLAT(2))^{T-1}]$

$EV(2,T)$ = Equalized valuation of all property in the school district in year T without the plant
$H(12)$ = Assessed valuation of all real property in the school district in year 1 without the plant
$H(13)$ = Market value of all tangible personal property in the school district in year 1 without the plant
$ART(T)$ = See equation 26
$H(6)$ = Assessed valuation of all tangible personal public utility property in the school district in year 1 without the plant
$INFLAT(2)$ = See equation 26
T = See equation 1

52. $EV(1,T) = EV(2,T) + \{[(H(1) \times 0.35 \times TAXAB(T)) + (H(10) \times ART(T))] \times [(1 + INFLAT(2))^{T-1}]\} + [H(2) \times 0.35 \times HC(T) \times (D(1,1,T) + D(1,2,T) + INS(T) + INC(T) + D(1,3,T))]$

EV(2,T) = See equation 51
H(1) = See equation 21
TAXAB(T) = See equation 21
H(10) = See equation 26
ART(T) = See equation 26
INFLAT(2) = See equation 26
T = See equation 1
H(2) = See equation 22
HC(T) = See equation 35
D(1,1,T) = See equation 1
D(1,2,T) = See equation 5
INS(T) = See equation 9
INC(T) = See equation 13
D(1,3,T) = See equation 17

53. $EM(2,T) = [\{[(H(13) \times ART(T)) + H(6)] \times [(1 + INFLAT(2))^{T-1}] \times (TAX(6) + TAX(3))\} + (\{(M(1,T) \times TAX(6)) + [(1 - TRF3(2,T)) \times TAX(3)]\} \times H(12))] / EV(2,T)$

If $EM(2,T) > 30$, then $EM(2,T) = 0$
If $EM(2,(T-1)) > EM(2,T)$, then $EM(2,T) = EM(2,(T-1))$

EM(2,T) = Equalized millage in the school district in year T without the plant
H(13) = See equation 51
ART(T) = See equation 26
H(6) = See equation 51
INFLAT(2) = See equation 26
T = See equation 1
TAX(6) = See equation 45
TAX(3) = See equation 45
M(1,T) = See equation 21
TRF3(2,T) = Tax reduction factor for real property in the school istrict in year T without the plant, adjusted to prevent the effective millage rate from dropping below 20
H(12) = See equation 51
EV(2,T) = See equation 51

54. $EM(1,T) = \{[(\{[H(12) + (H(1) \times 0.35 \times TAXAB(T))] \times M(1,T)\} + (H(2) \times M(4,T) \times 0.35 \times HC(T)) \times TAX(6)] + (\{H(12) + (H(1) \times 0.35 \times TAXAB(T)) + [H(2) \times (D(1,1,1) + D(T,2,1) + INS(1) + INC(1) + D(1,3,1) \times 0.35 \times HC(T)]\} \times (1 - TRF3(1,T)) \times TAX(3)) + (\{[(H(13) + H(10)) \times ART(T)] + H(6)\} \times [(1 + INFLAT(2))^{T-1}] \times (TAX(6) + TAX(3)))\} / EV(1,T)$

If $EM(1,T) > 30$, then $EM(1,T) = 30$
If $EM(1,(T-1)) > EM(1,T)$, then $EM(1,T) = EM(1,(T-1))$

EM(1,T) = Equalized millage in the school district in year T with the plant
H(12) = See equation 51
H(1) = See equation 21

TAXAB(T) = See equation 21
M(1,T) = See equation 21
H(2) = See equation 22
M(4,T) = See equation 35
HC(T) = See equation 35
TAX(6) = See equation 45
D(1,1,1) = See equation 1
D(1,2,1) = See equation 5
INS(1) = See equation 9
INC(1) = See equation 13
D(1,3,1) = See equation 17
TRF3(1,T) = See equation 45
TAX(3) = See equation 45
H(13) = See equation 51
H(10) = See equation 26
ART(T) = See equation 26
H(6) = See equation 51
INFLAT(2) = See equation 26
T = See equation 1
EV(1,T) = See equation 52

55. $SG(1) = 65. \times [(1 + INFLAT(4))^{T-1}]$

SG(1) = The level of revenue the state guarantees each school district will receive per pupil per mill for the first 20 mills levied
INFLAT(4) = Annual rate of change in school district revenues
T = See equation 1

56. $SG(2) = 42. \times [(1 + INFLAT(4))^{T-1}]$

SG(2) = The level of revenue the state guarantees each school district will receive per pupil per mill for mills levied above 20 but not greater than 30
INFLAT(4) = See equation 55
T = See equation 1

57. $FH(1) = \{SG(1) - [EV(2,T)/(ADM(2,T) \times 1000)]\} \times ADM(2,T) \times 20$
If $FH(1) < 0$, then $FH(1) = 0$

FH(1) = The level of state aid to the school district in year T without the plant according to the first half of the guaranteed yield formula
SG(1) = See equation 55
EV(2,T) = See equation 51
ADM(2,T) = See equation 49

58. $FH(2) = \{SG(2) - [EV(2,T)/(ADM(2,T) \times 1000)]\} \times ADM(2,T) \times (EM(2,T) - 20)$
If $FH(2) < 0$, then $FH(2) = 0$

FH(2) = The level of state aid to the school district in year T without the plant according to the second half of the guaranteed yield formula
SG(2) = See equation 56
EV(2,T) = See equation 51
ADM(2,T) = See equation 49
EM(2,T) = See equation 53

59. $FORM(2,T) = FH(1) + FH(2)$
$SBA(2,T) = FORM(2,T)$

FORM(2,T) = The level of state aid to the school district in year T without the plant according to the guaranteed yield formula
FH(1) = See equation 57
FH(2) = See equation 58
SBA(2,T) = The actual level of state aid to the school district in year T without the plant

60. $FH(3) = \{SG(1) - [EV(1,T)/(ADM(1,T) \times 1000)]\} \times ADM(1,T) \times 20$
If $FH(3) < 0$, then $FH(3) = 0$

FH(3) = The level of state aid to the school district in year T with the plant according to the first half of the guaranteed yield formula
SG(1) = See equation 55
EV(1,T) = See equation 52
ADM(1,T) = See equation 50

61. $FH(4) = \{SG(2) - [EV(1,T)/(ADM(1,T) \times 1000)]\} \times ADM(1,T) \times (EM(1,T) - 20)$
If $FH(4) < 0$, then $FH(4) = 0$

FH(4) = The level of state aid to the school district in year T with the plant according to the second half of the guaranteed yield formula
SG(2) = See equation 56
EV(1,T) = See equation 52
ADM(1,T) = See equation 50
EM(1,T) = See equation 54

62. FORM(1,T) = FH(3) + FH(4)
SBA(1,T) = FORM(1,T)

FORM(1,T) = The level of state aid to the school district in year T with the plant according to the guaranteed yield formula
FH(3) = See equation 60
FH(4) = See equation 61
SBA(1,T) = The actual level of state aid to the school district in year T with the plant

63. GUAR(2,T) = SBA[2,(T-1)] x (1 + INFLAT(4))

GUAR(2,T) = The minimum level of state aid to the school district in year T without the plant
SBA(2,T) = See equation 59
INFLAT(4) = See equation 55

64. GUAR(1,T) = SBA[1,(T-1)] x (1 + INFLAT(4))

GUAR(1,T) = The minimum level of state aid to the school district in year T without the plant
SBA(1,T) = See equation 62
INFLAT(4) = See equation 55

65. If GUAR(2,T) > FORM(2,T) then SBA(2,T) = GUAR(2,T)

GUAR(2,T) = See equation 63
FORM(2,T) = See equation 59
SBA(2,T) = See equation 59

66. If GUAR(1,T) > FORM (1,T) then SBA(1,T) = GUAR(1,T)

GUAR(1,T) = See equation 64
FORM(1,T) = See equation 62
SBA(1,T) = See equation 62

67. $SA(T,3) = SBA(1,T) - SBA(2,T) + \left[\left(\left\{TRANS \times [(1 + INFLAT(3))^{T-1}]\right\} / H(11)\right) \times H(9)\right]$

SA(T,3) = Additional state aid to the school district in year T as a result of the plant
SBA(1,T) = See equation 62
SBA(2,T) = See equation 59
TRANS = Transportation aid in year 1 to the school district from the state
INFLAT(3) = See equation 3
T = See equation 1
H(11) = See equation 49
H(9) = See equation 47

68. $D(1,6,T) = G(1,3,T) + G(2,3,T) + G(3,3,T) + G(8,3,T) + SA(T,3)$

$D(1,6,T)$ = Additional revenues received by the school district in year T as a result of the plant
$G(1,3,T)$ = See equation 45
$G(2,3,T)$ = See equation 46
$G(3,3,T)$ = See equation 47
$G(8,3,T)$ = See equation 48
$SA(T,3)$ = See equation 67

69. $G(6,3,T) = P(2) \times [(1 + P(4))^{T-1}] \times H(9)$

$G(6,3,T)$ = Additional operating expense for schools due to new students
$P(2)$ = Operating expense of entire school district in year 1 on a per student basis
$P(4)$ = Annual rate of change in school district expenditures per student
T = See equation 1
$H(9)$ = See equation 47

70. $D(2,6,T) = G(6,3,T) + SITE(T,3)$

$D(2,6,T)$ = Additional expense to the school district in year T due to the plant
$G(6,3,T)$ = See equation 69
$SITE(T,3)$ = Additional annual capital expense to the school district in year T

71. $D(3,6,T) = (D(1,6,T) - D(2,6,T))/[(1 + INFLAT(3))^{T-1}]$

$D(3,6,T)$ = Net impact of the plant on the school district in year T in constant dollars
$D(1,6,T)$ = See equation 68
$D(2,6,T)$ = See equation 70
$INFLAT(3)$ = See equation 3
T = See equation 1

72. $E(6) = \sum\{D(3,6,T)/[(1 + RATE)^{T}]\}$

$E(6)$ = Present value of the net impact of the plant on the school district
$D(3,6,T)$ = See equation 71
$RATE$ = See equation 4
T = See equation 1

Appendix B

State and Federal Aid to Municipalities and Counties

State and federal financial aid are important sources of revenue for municipalities and counties, providing these local units with 17 and 15.4 percent, respectively, of their funds in 1976. As this appendix will show, local growth only increases two forms of aid: 1) motor vehicle license fees from the state and 2) federal revenus ahring. All of the other programs either are unaffected by growth or result in negligible changes. Each of these programs is now reviewed to demonstrate this conclusion.

The state programs reviewed are: 1) motor vehicle fund tax, 2) motor vehicle license fees, 3) state local government fund, 4) county undivided local government fund, 5) estate and inheritance taxes, 6) liquor and beer permits, and 7) cigarette licenses.

Motor Vehicle Fuel Tax

The state of Ohio collects 7¢ per gallon on motor vehicle fuel. One-fourth of this is distributed to local highway programs while the other three-fourths goes to state programs. While a total of 7¢ is collected per gallon, this is divided between four separate tax levies. Two cents goes for gasoline excise tax fund and municipalities receive 30% of this fund.[1/] The excise fund is allocated in proportion to motor vehicle registrations. The highway construction fund receives 2¢ per gallon and 7½ percent goes to the municipalities in proportion to their motor vehicle registrations.

1/ R. C. Section 5735.23 and 1977 Annual Report of the Department of Taxation, pp. 34-35, Burchell and Listokin provide a procedure for the redistribution of state levied motor vehicle taxes based on an equally weighted share of the locality's proportion of population and road mileage to total state population and road mileage (pp. 199-200). Since this procedure obviously does not apply in Ohio, it is not discussed in detail. The Battelle study did not project changes in gasoline tax revenues to municipalities.

In summary, the formula for this revenue is:

(1) $M_m = .0075\ R_m G$

where

M_m = the funds from the motor vehicle fuel tax assigned to a specific municipality

R_m = proportion of the state's motor vehicle registration in the municipality

G = gallons of additional gasoline utilized as a result of the growth

When the change in motor vehicle fuel tax based on a per capita multiplier approach is compared with the results from this formula, the results differ substantially. For example, in the city of Athens gasoline taxes in 1977 were $66,792 or approximately $3.33 per person. Assuming an average household size of three persons, this yields $10.02 per household. For an additional 100 households, each with one car, this would yield $1,002 of additional motor vehicle fuel tax. However, calculating the change using the above formula results in an increase of only 2.5 cents per 100 households.2/ It is obvious from these results that the impact of additional gasoline consumption is very small in the small to medium cities. Consequently, it is omitted from this model.

Motor Vehicle License Fees

Thirty-four percent of the motor vehicle license fees are returned to the municipality in which the vehicle is registered.3/ To approximate the

2/ The latter estimate was made assuming that the proportion of motor vehicles registered in the municipality could be approximated by the ratio of local population to state population. It was assumed the family drove 18,000 miles per year and averaged 15 miles per gallon for a total consumption of 12,000 gallons/year. See Appendix .

3/ Ohio Revised Code 4501.04 or see Ohio's Taxes, pp. 22-24.

change, it is assumed that the fee revenues increase in proportion to population.[4/] The equation is:

(2) $LF = (L/P) \times J \times R_j$

where

LF = new revenue from the motor vehicle license fees

L = revenue from the motor vehicle fees in previous year

P = population in the jurisdiction in previous year

J = number of new jobs in the plant

R_j = the number of residents per employee

For example, in the city of Athens in 1977 adding 100 jobs would add $942 per year.[5/]

State Local Government Fund

Three and one-half percent of the revenues from the state sales tax, state income tax, and corporate franchise tax go into the state local government fund. One-twelfth of this state fund is distributed to municipalities with local income taxes. The 1/12 of the fund allocated to these cities is divided in proportion to that city's share of all municipal income taxes collected in the state in the second calendar year preceding the year of the fund's distribution.

(3) SLGF = .035 (CFT + ST + PIT)

where

SLGF = state local government fund

CFT = corporation franchise tax revenue

ST = sales tax revenue

PIT = personal income tax revenue

4/ This approach was also used by Battelle (p. 281).

5/ This is based on $45,224 of revenue in 1977, an estimated 12,000 local residents, and 2.5 residents per worker. The 12,000 local residents assumes that all Ohio University students do not register their cars locally. If the municipality has permissive fees of $5.00 per vehicle, the revenue from this would be added to the revenue available from the state and the same procedure used to estimate the additional revenue due to growth. Municipalities can only levy this fee if the county has not adopted it.

(4) $M_i = 1/12\ SLGF * MIR$

where

M_i = allocation to municipality i

MIR = ratio of the municipalities income taxes to the sum of all municipal income tax collected in the state

While the local government fund is an important source of state aid, changes in employment of moderate size firms (100-300 jobs) makes such a small adjustment in the allocation to a municipality that it can be omitted.

County Undivided Local Government Fund

Municipalities also receive additional funds through the county undivided local government fund. A municipality might receive additional amounts of these funds as growth occurred since the distribution between jurisdictions within the county depends on the "needs" of the various recipient units as defined by county budget commission. However, since growth might have either a positive or negative impact on local units of government, it is difficult to predict changes in this source of state aid.[6/] While growth will not necessarily increase local government funds in a significant or predictable fashion, it is highly unlikely tc precipitate reduction in this form of aid. An exception to this might be if growth would generate a surplus of other revenues sufficient enough to reduce local "needs" and consequently decrease county undivided fund revenues to a municipality.

Estate and Inheritance Taxes

Fifty percent of the gross taxes received through the estate and inheritance taxes are distributed to the municipality or township in which the tax

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6/ See the 1977 Annual Report of the Ohio Department of Taxation, pp. 104-105. Neither the Battelle study nor Burchell and Listokin provide estimation procedures for this type of state aid.

originates.[7/] A per capita approach could be used to estimate future receipts. However, the variation in annual receipts would require an average from several years. In this model it is assumed that the in-migrants are young enough so that additional revenue collected as a result of growth will be negligible.[8/]

Liquor and Beer Permits and Cigarette Licenses

Growth might stimulate an additional volume of retail trade in existing establishments or encourage the establishment of new retail outlets for these items.

It is assumed that the additional workers associated with a new firm of moderate size would only increase the volume of business for existing retailers, rather than promote the establishment of new retailing firms. If this is the case, then no additional revenue is generated.

The Battelle study assumed that cigarette license revenue would increase in proportion to the population. The employment change which Battelle analyzed was larger than ones likely to be considered by this model. However, no justification given for the assumption used in the Battelle study would make it preferred to the approach used here.

State Aid to the County

The major state-levied taxes distributed to counties are: 1) state local government fund, 2) motor vehicle license fees, and 3) motor vehicle fuel tax. Federal assistance is received through the federal revenue-sharing program and CETA.[9/]

7/ 1977 Annual Report of the Ohio Department of Taxation, pp. 94-97.

8/ The Battelle study makes this same assumption (p. 277). Estate and inheritance taxes are not discussed by Burchell and Listokin.

9/ Public assistance and welfare funds from federal programs are administered through county governments.

The state's local government fund would systematically increase with growth in local population. The formula for distribution of the state local government fund is:

(5) $C_i = (11/12\ SLGF) * .75\ CMPR * .25\ CPIR$

where

SLGF = state local government fund

CMPR = ratio of county's municipal property tax valuation to the sum for all municipalities

CPIR = ratio of county's population to the state

Recall that the state fund SLGF increases by only 3.5 percent of the increase in the revenues from the corporate franchise tax, the sales tax, and the income tax. This means that a new plant results in very minor changes in the state fund. Any increases are distributed by formula 5 resulting in almost no perceptible increase in the county in which growth occurs.

Motor vehicle license fees will increase as motor vehicle registration increases. Forty-seven percent of the state collected revenue is returned to the county in which the vehicle owner resides. The rate varies by type and weight of vehicle. The only practical estimation procedure is the per capita multiplier approach described earlier for municipalities.

Motor vehicle fuel tax revenues are distributed to counties on the basis of an equal amount going to each of Ohio's 88 counties. Each county receives 7.4 cents per 1000 gallons of gasoline sold across the state. Obviously, the prospect that a medium-size firm could significantly affect statewide consumption of gasoline is remote. To increase a county's revenue from this source by only $100 would take an increase consumption of 1.3 million gallons. For this reason, the effect of growth on this revenue source has been omitted.

Federal Revenue Sharing

The impact of population changes on revenue for municipal governments is shown below. The equation for revenue sharing is:

$$(6) \quad R_L = R_S \left(\frac{P_L}{P_L + P_R} \times \frac{T_L}{T_S} \times \frac{Y_L}{Y_S} \right)$$

where

R_L = Federal revenue sharing funds due to a community

R_S = State federal revenue sharing funds to distribute to localities

P_L = Local population

P_R = Population in state minus P_L

T_L = Local tax effort

T_S = Average state tax effort

Y_L = Local per capita income

Y_S = State per capita income

The partial derivative of R_L with respect to P_L is:

$$(7) \quad \frac{d}{P_L} \; R_L = \left(\frac{P_R}{P_L^2 + 2P_LP_2 + P_R^2)} \right) k$$

$$(8) \quad \text{where } k = R_S * \frac{T_L}{T_S} * \frac{Y_L}{Y_S}$$

This assumes that the tax effort and income per capita ratios remain unchanged by the growth.

By multiplying both numerator and denominator of (8) by $P_2/(P_3)$ where $P_S = P_2 + P_R$, we get:

$$(9) \quad k = \frac{k \left(\frac{P_2}{P_S}\right)}{\frac{P_2}{P_S}} = \frac{\left(R_S * \frac{P_2}{P_3} * \frac{T_2}{T_3} * \frac{Y_2}{Y_3} \right)}{\frac{P_2}{P_3}}$$

This is simply the local revenue received divided by the ratio of local to state population. For example, in Athens County in 1977 would be:

$$(10) \quad k = \frac{297,130}{\frac{20,000}{10,000,000}} = \frac{297,130}{.002}$$

$$k = 148,565,000$$

The partial is then approximately:

(11) $$\frac{R_L}{P_L} = 148{,}565{,}000 * .0000001 = \$14.86$$

This is almost identical to the increase obtained by using the per capita revenue approach.

Appendix C

Tax Reduction Factors

The tax reduction factor became effective October 11, 1976.[1/] The general process is described in the text. The description of how this procedure handles new construction is confusing in both Ohio's Taxes and the 1977 Annual Report of the Department of Taxation (p. 111). The Ohio's Taxes explanation reads:

> "Under a new state law first effective for the 1976 tax year (1977 collections), percentage reductions are applied to taxes levied against real property being reappraised or updated. These reduction factors remain in effect until there is a new increase in value (excluding new construction). New reduction factors are then calculated and applied. The computations of these percentage reductions is a rather complex process. However, the basic effect is to eliminate increases in voted taxes which might occur when existing real property in a taxing unit is reappraised or updated." (p. 39)

Two interpretations are possible on how new properties are handled. The first interprets this as meaning that improvements on property are handled as if there were no tax reductions during the first year. The second view is that all property, even that constructed after 1977, is deflated by the tax reduction factor to 1977 levels.

The later view is the correct interpretation. This is because the factors apply to all properties rather than just existing properties and also they are cumulative.

1/ See Am. Sub. H. B. 920 or R. C. 319.301.

Bulletin 7 of the Department of Tax Equalization explains this procedure used to compute the tax reduction factors. The steps used to calculate this factor also show that the tax reduction factors apply to all properties. For the first year Bulletin 7 explains the computation as follows:

> In a taxing district where the tax reduction factor is applied or a new levy levied for the first time the reduction factor is calculated by dividing the increase in taxable value of real property, including public utility real not including new improvements by the current year's value of such property not including new improvements as follows:

	Real Property Taxable Value
Current Year	$21,000,000
Less new improvements	2,000,000
Current year's value not including new improvements	$19,000,000
Previous year's after remitters and additions	$10,000,000
Increase less new improvements	$ 9,000,000

> Tax Reduction Factor = $9,000,000 ÷ 19,000,000 or .473684
>
> Note that the tax reduction factor is carried to six decimal places.

Thus, the new improvements are simply removed from the district's taxable value to calculate the reduction factor. "The reduction factor is then applied uniformly to taxes levied on all real property in the district <u>existing</u> or new."[2/]

In most local governments the tax reduction factor essentially freezes outside millage tax levies, but it operates somewhat differently for school districts. These differences will now be explained.

2/ Correspondence from Robert Kinney, Commissioner of the Ohio Department of Tax Equalization, to J. David Gerard September 13, 1978.

Section 319.301 of the Ohio Revised Code states that in a school district if a tax reduction factor "could cause the total taxes charged and payable for current expenses...to be less than two percent of the taxable value of all real property subject to taxation by the district, the (county) auditor shall so notify the commissioner (of tax equalization), and the commissioner shall determine what percentages would cause the district's total taxes charged and payable for current expenses...to equal...two percent of such taxable value... The auditor shall use such percentages..." In effect, the State of Ohio exempts school districts from the impact of the freeze on revenues from outside millage on real property, if that freeze would cause the effective millage on real property in a school district to drop below twenty mills.

In districts with twenty mills "on the books," there is a floor of twenty mills for the effective tax rate. In districts where the official millage is greater than twenty, the minimum is greater than twenty with the precise amount being dependent on the official millage rate and the relative size of the real and tangible personal property tax bases.

The effective tax rate is important because it is used in determining the amount of state support to which each school district is entitled. Twenty mills must be collected for a district to receive any state money. For each of the first ten mills above twenty, a district is guaranteed $42 more per student. This doesn't sound like much, but in a typical school district of 2,500 students, each mill above twenty (and up to thirty) represents a state guarantee of over $100,000.

For the Ohio Growth Impact Model, the adjustment which prevents the effective millage rate on real property from dropping below twenty is handled by two sets of five equations. The two sets differ only in that the equations with a subscript of 1 adjust with a new firm while those with a subscript of 2 adjust without a new firm. The first equation calculates the value of the effective or equalized millage for real property.

The second equation examines the effective millage to determine whether or not the tax reduction factor will need to be adjusted. If the effective millage rate is greater than or equal to twenty, no adjustment is needed. If it is less than twenty, the remaining equations are used to make the adjustment.

The third equation estimates how much revenue would be raised if the effective real property millage rate was actually twenty. The fourth equation determines how much revenue would be raised by the outside millage, given that revenues from the inside millage are not frozen.

The fifth equation is derived from the formula for the revenue from outside millage on real property. The steps needed to obtain the fifth equation are shown below. An adjusted tax reduction factor, which will prevent the effective real property millage rate from dropping below twenty, is the result.

EQUATIONS

OSMR = TB * TAX * (1-TRF)

where

OSMR = outside millage revenue from real property
TB = real property tax base
TAX = outside millage rate
TRF = tax reduction factor

1-TRF = OSMR/(TB * TAX)

TRF = 1 - (OSMR/(TB * TAX))

```
EFM(2,T) = TAX(6) + ((H(12) * (1.-TRF(3))* TAX(3))/(H(12) * M(1,T)))
```

where

```
EFM(2,T) = effective real property millage of school district in year T
           if plant does not locate
  TAX(6) = inside millage in school district in year 1
   H(12) = assessed valuation of all real property in school district
           in year 1, not including new plant
  TRF(3) = tax reduction factor in school district in year 1
  TAX(3) = outside millage in school district in year 1
  M(1,T) = index of change since year 1 in the value of property in
           year T, adjusted to reflect change only once every three years
```

```
IF (EFM(2,T).GE.20)  TRF3(2,T) = TRF(3)
```

where

```
 EFM(2,T) = effective real property millage of school district in year T
            if plant does not locate
TRF3(2,T) = tax reduction factor in school district in year T if the
            new plant does not locate, adjusted so as to prevent the
            effective millage rate from dropping below 20
   TRF(3) = tax reduction factor in school district in year 1
```

```
TR(2) = H(12) * M(1,T) * 0.02
```

where

```
 TR(2) = total revenue for school district from tax on real property in
         year T at 20 mills if plant does not locate
 H(12) = assessed valuation of all real property in school district in
         year 1, not including new plant
M(1,T) = index of change since year 1 in the value of property in year T,
         adjusted to reflect change only once every three years
```

```
OSMR(2) = TR(2) - (H(12) * TAX(6) * 0.001 * M(1,T))
```

where

```
OSMR(2) = revenue from the outside millage on real property in year T,
          not including new plant
  TR(2) = total revenue for school district from tax on real property in
          year T at 20 mills if plant does not locate
  H(12) = assessed valuation of all real property in school district in
          year 1, not including new plant
 TAX(6) = inside millage in school district in year 1
 M(1,T) = index of change since year 1 in the value of property in year T,
          adjusted to reflect change only once every three years
```

TRF3(2,T) = 1. - (OSMR(2)/(H(12) * TAX(3) * 0.001))

where

TRF3(2,T) = tax reduction factor in school district in year T if plant does not locate, adjusted so as to prevent the effective millage rate from dropping below 20
OSMR(2) = revenues from outside millage on real property in year T, not including new plant
H(12) = assessed valuation of all real property in school district in year 1, not including new plant
TAX(3) = outside millage in school district in year 1

EFM(1,T) = TAX(6) + (((H(12) + (H(1) * 0.35 * TAXAB(T)) + (H(2) * (D(1,1,1) + D(1,2,1) + INS(1) + INC(1) + D(1,3,1)) * 0.35 * HC(T))) * (1.-TRF(3)) * TAX(3))/((H(12) * M(1,T)) + (H(1) * 0.35 * TAXAB(T) * M(1,T)) + (H(2) * M(4,T) * 0.35 * HC(T))))

where

EFM(1,T) = effective millage of school district in year T if plant locates
TAX(6) = inside millage in school district in year 1
H(12) = assessed valuation of all real property in school district in year 1, not including new plant
H(1) = market value of improvements to plant site in year 1
TAXAB(T) = dummy variable which equals 0 if a tax abatement is given and 1 if an abatement is not given
H(2) = ratio of house values to annual gross incomes
D(1,1,1) = increased annual income to employees in city in year 1
D(1,2,1) = increased annual income to employees in the balance of the county in year 1
INS(1) = annual income of all in-migrants to the city working at the plant in year 1
INC(1) = annual income of all in-migrants to the balance of the county working at the plant in year 1
D(1,3,1) = net benefits to service sector in city in year 1 resulting from expanded consumption
HC(T) = proportion of new or improved homes in county in year T lying outside redevelopment zone with tax abatement
TRF(3) = tax reduction factor in school district in year 1
TAX(3) = outside millage in school district in year 1
M(1,T) = index of change since year 1 in the value of property in year T, adjusted to reflect change only once every three years
M(4,T) = sumation of net benefits to employees in county in year T, adjusted to reflect change only once every three years

IF (EFM(1,T).GE.20) TRF3(1,T) = TRF(3)

where

EFM(1,T) = effective millage of school district in year T if plant locates
TRF3(1,T) = tax reduction factor in school district in year T if plant does locate, adjusted so as to prevent the effective millage rate from dropping below 20
TRF(3) = tax reduction factor in school district in year 1

TR(1) = ((H(12) * M(1,T)) + (H(1) * 0.35 * TAXAB(T) * M(1,T)) + (H(2) * M(4,T) * 0.35 * HC(T))) * 0.02

where

TR(1) = total revenue for school district from tax on real property in year T at 20 mills, if plant does locate
H(12) = assessed valuation of all real property in school district in year 1, not including new plant
H(1) = market value of improvements to plant site in year 1
TAXAB(T) = dummy variable which equals 0 if a tax abatement is given and 1 if an abatement is not given
M(1,T) = index of change since year 1 in the value of property in year T, adjusted to reflect change only once every three years
H(2) = ratio of house values to annual gross incomes
M(4,T) = sumation of net benefits to employees in county in year T, adjusted to reflect change only once every three years
HC(T) = proportion of new or improved homes in county in year T lying outside redevelopment zone with tax abatement

OSMR(1) = TR(1) - (((H(12) * M(1,T)) + (H(1) * 0.35 * TAXAB(T) * M(1,T)) + (H(2) * M(4,T) * 0.35 * HC(T))) * TAX(6) * 0.001)

where

OSMR(1) = revenue from outside millage on real property in year T, including new plant
TR(1) = total revenue for school district from tax on real property in year T at 20 mills, if plant does locate
H(12) = assessed valuation of all real property in school district in year 1, not including new plant
M(1,T) = index of change since year 1 in the value of property in year T, adjusted to reflect change only once every three years
H(1) = market value of improvements to plant site in year 1
TAXAB(T) = dummy variable which equals 0 if a tax abatement is given and 1 if an abatement is not given
H(2) = ratio of house values to annual gross incomes
M(4,T) = sumation of net benefits to employees in county in year T, adjusted to reflect change only once every three years
HC(T) = proportion of new or improved homes in county in year T lying outside redevelopment zone with tax abatement
TAX(6) = inside millage in school district in year 1

TRF3(1,T) = 1. - (OSMR(1)/((H(12) + (H(1) * 0.35 * TAXAB(T)) + (H(2) * (D(1,1,1) + D(1,2,1) + INS(1) + INC(1) + D(1,3,1)) * 0.35 * HC(T))) * TAX(3) * 0.001))

where

TRF3(1,T) = tax reduction factor in school district in year T if plant does locate, adjusted so as to prevent the effective millage rate from dropping below 20
OSMR(1) = revenue from outside millage on real property in year T, including new plant
H(12) = assessed valuation of all real property in school district in year 1, not including new plant

H(1) = market value of improvements to plant site in year 1
TAXAB(T) = dummy variable which equals 0 if a tax abatement is given and 1 if an abatement is not given
H(2) = ratio of house values to annual gross incomes
D(1,1,1) = increased annual income to employees in city in year 1
D(1,2,1) = increased annual income to employees in the balance of the county in year 1
INS(1) = annual income of all in-migrants to the city working at the plant in year 1
INC(1) = annual income of all in-migrants to the balance of the county working at the plant in year 1
D(1,3,1) = net benefits to service sector in city in year 1 resulting from expanded consumption
HC(T) = proportion of new or improved homes in county in year T lying outside redevelopment zone with tax abatement
TAX(3) = outside millage in school district in year 1

Appendix D

Percentage Increase in Employee Wages

in 11 New or Expanded Plants in Southeast Ohio

Firm	Current[1] Wage in Plant ($/Hour)	Hourly[2] Gain in Wages ($/Hour)	Previous[3] Wage ($/Hour)	Percent[4] Increase in Wages
1	3.73	1.21	2.52	48
2	2.51	1.22	1.29	95
3	3.85	.98	2.87	34
4	3.61	.98	2.63	37
5	3.18	1.35	1.83	74
6	2.95	2.61	0.34	768
7	4.18	1.86	2.32	80
8	3.00	0.74	2.26	33
9	3.00	0.61	2.39	26
10	3.00	0.81	2.19	37
11	4.00	1.24	2.76	45
Weighted Average	3.22	1.22	2.00	61

Source: Derived from data presented in Morse and Hushak as described felow.

[1]Current wages are reported in Table 2 of Morse and Hushak.

[2]The hourly gain in wages was estimated by dividing the annual increase per worker (Table 7) by 2080 hours.

[3]Previous wages are estimated as the difference between columns 1 and 2.

[4]The percentage increase shows the percentage gain in wages over the previous job.

Appendix E

Procedure to Adjust Real Property Values For Assessment Update and Reappraisals

The assessed values of real property in Ohio do not change annually. Appraisals are carried out in each county every six years, in which each property is reviewed and assigned a new valuation based on inflation, condition of the property, and other factors. Three years after the appraisal, an update of all real property valuations is made by multiplying each parcel of land property in a given tax district by an inflation factor. This factor is based on recent selling prices of similar properties in the area. The effect is that real property values in Ohio change once every three years.

Due to the use of various means of inflating real property values in the Growth Impact Model, four different inflation variables are needed. One is derived from the annual rate of change in property values and is given the variable name M(1,T). Another is based on the average annual rate of inflation and is named M(3,T). Two other inflation variables, M(2,T) and M(4,T) are derived from projected net changes in personal incomes due to the location of a new plant. Changes in personal incomes are used because the change in valuation of some types of real property are estimated in the model using the assumption that the ratio of home values to incomes is relatively constant. The two variables are different only in the respect that M(4,T) includes the income impacts in the county while M(2,T) covers only the city.

Values for each of the four variables are generated for each year of the study by the series of fortran statements shown in this appendix. These statements may be divided into four sections, each of which performs a different function.

Section I establishes first-year values for each of the variables. Since M(1,T) and M(3,T) are actually inflation indexes, their first-year values both equal 1. Since variables M(2,T) and M(4,T) are really estimates of income impacts (for which the values will be "frozen" for three years at a time), their first-year values are simply the sumation of the first-year values of the appropriate component income impacts.

Section II merely sets the values of each variable for all years after the first equal to zero.

In Section III, values are established for each variable in the years of reappraisal or updating. The input variable N allows the model user to specify in which of the initial three years of the study property valuations will first change. At the end of the Section III statements, values will exist for each variable for the first year and each year in which an appraisal or update would take effect. All other years would equal zero at this point.

The statements in Section IV change the value of each variable in years in which they equal zero to the same value as that variable in the year before. In other words, if M(1,4) equals 1.25 and M(1,5) equals zero, at the end of Section IV M(1,5) would also equal 1.25. As the processing moves through the Section IV statements, each of the four variables will be assigned a value for each year, such that the values change only once every three years.

EQUATIONS

Section I.

```
M(1,1) = 1.
M(2,1) = D(1,1,1) + INS(1) + D(1,3,1)
M(3,1) = 1.
M(4,1) = D(1,1,1) + D(1,2,1) + INS(1) + INC(1) + D(1,3,1)
```

where

M(1,1) = index of change by year 1 in the value of real property
M(2,1) = sumation of net benefits to employees in city in year 1
M(3,1) = index of change by year 1 in the overall cost of living
M(4,1) = sumation of net benefits to employees in county in year 1
D(1,1,1) = increased annual income to employees in city in year 1
D(1,2,1) = increased annual income to employees in the balance of the county in year 1
INS(1) = annual income of all in-migrants to the city working at the plant in year 1
INC(1) = annual income of all in-migrants to the balance of the county working at the plant in year 1
D(1,3,1) = net benefits to service sector in city in year 1 resulting from expanded consumption

Section II.

```
    DO 20    I = 2, TIME
    DO 21    J = 1, 4
    M(J,I) = 0
 21 CONTINUE
 20 CONTINUE
```

where

TIME = number of years to be studied

Section III.

```
    DO 22 I = N, TIME 3
    M(1,I) = (1. + INFLAT(2)) ** (I-1)
    M(2,I) = D(1,1,I) + INS(I) + D(1,3,I)
    M(3,I) = (1. + INFLAT(3)) ** (I-1)
    M(4,I) = D(1,1,I) + D(1,2,I) + INS(I) + INC(I) + D(1,3,I)
 22 CONTINUE
```

where

N = dummy variable which equals 1 if the first year of the study is the first year of a new property valuation, 2 if the first year of the study is the second year of a valuation, and 3 if the first year of the study is the third year of a valuation

M(1,I) = index of change by year I in the value of real property
M(2,I) = sumation of net benefits to employees in the city in year I
M(3,I) = index of change by year I in the overall cost of living
M(4,I) = sumation of net benefits to employees in the county in year I
INFLAT(2) = annual percentage change in property values
I = time
INFLAT(3) = average annual rate of inflation
D(1,1,I) = increased annual income to employees in city in year I
D(1,2,I) = increased annual income to employees in the balance of the county in year I
INS(I) = annual income of all in-migrants to the city working at the plant in year I
D(1,3,I) = net benefits to service sector in city in year I resulting from expanded consumption
INC(I) = annual income of all in-migrants to the balance of the county working at the plant in year I

Section IV.

```
    DO 93  T = 1, TIME
    DO 94  J = 1,4
    IF (M(J,T).EQ.0) M(J,T) = M(J(T-1))
 94 CONTINUE
 95 CONTINUE
```

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